

# **International Arament Cooperative Programs: Benefits, Liabilities, and Self-Inflicted Wounds – The JSF As A Case Study**

by

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## **Abstract**

The Joint Strike Fighter international program is unique; indeed there is no other example of a U.S. major prime contractor co-developing and co-producing a U.S. combat aircraft with other foreign entities. Consequently, the program provides an excellent model to evaluate in view of the new Department of Defense international acquisition strategy requirements. This paper is a preliminary analysis that seeks to answer the questions: what are the benefits and liabilities of the JSF international acquisition approach thus far, and what are the necessary precursors or conditions that should exist for future international cooperative programs to have the best chance of success? Such answers are relevant given that DoD now looks to international armament cooperative programs as the first option for future weapon systems acquisition strategies. Finally, the paper will identify barriers that are ‘hard-wired’ into our acquisition regulations, policies and statutes that restrict cooperation, fail to take advantage of the global defense industrial market, and are antithetical to our National Security Strategy coalition goals. The paper concludes with recommendations intended to improve the success for future international cooperative initiatives.

# **Chapter 1**

## **Introduction**

The history of the 20th century has proven time and again that America's security is linked directly to that of other nations, and that America's prosperity depends on the prosperity of others. America seeks to use its current political, economic, and military advantages not to dominate others, but to build a durable framework upon which the United States and its allies and friends can prosper in freedom now and into the future.

Quadrennial Defense Review, September 2000

In May 1994, the Principal Undersecretary of Defense for Acquisition and Technology requested the Defense Science Board review the Joint Advanced Strike Technology study program. Specifically, the Secretary wanted to know, “[w]hat are the benefits and disadvantages of international cooperation intended to produce favorable foreign sales of the Joint Advanced Strike study products, thereby reducing overall cost to the U.S.?” At study completion, the board concluded the next generation fighter should be developed with the foreign market in mind (as with the F-16) but not adopt the international cooperation model for development and production. The board summarized it this way, “[f]oreign participation in co-development of [the] next generation fighter, other than limited participation for special reasons, would complicate the program to the point of reducing the probability of success.”<sup>1</sup> The board went on to note “mixed results” associated with co-development programs, producing only “expense and bad feelings” and when they appeared to work, they did so only at a high cost.

In July 2005 DoD 5000.1 regulation for the defense acquisition system required all programs to consider international cooperation approaches before any joint or service specific materiel solutions. This signaled a significant change for weapon system acquisition strategies and a departure from the earlier Defense Science Board recommendation (see Appendix). What occurred in the intervening 11 years? Why is JSF now considered by DoD to be the model international armament cooperative program?<sup>2</sup>

This research began with the intent to analyze the JSF international acquisition strategy, arguing first for and then against the JSF model for



future tactical aircraft acquisitions. As proper for a research paper, no conclusion was assumed. After extensive review, however, the research did not support a compelling argument against the approach. Rather, what fell out were essential conditions for success and existing barriers in the U.S. statutes, regulations, and policies that must be removed to realize an international cooperation program's full benefit. This is not to say that there are no good examples of bad cooperative programs; there are many, but the same can also be said of indigenous programs.

The JSF makes an interesting case study because it has incorporated many of the lessons learned from previous programs. Indeed, there is no other example of a U.S. major prime contractor co-developing and producing a U.S. combat aircraft with another foreign company. Consequently, JSF provides an excellent model to evaluate in view of the new DoD international acquisition strategy requirements. It must be noted that the vote is still out on the ultimate success or failure of the model, since the program is only into its fourth year of a twelve-year System Development and Demonstration phase. This paper is therefore a preliminary analysis that seeks to answer the questions: what are the benefits and disadvantages of the JSF international acquisition approach thus far, and what are the necessary precursors or conditions that should exist for future programs to have the best chance of success? Such answers are relevant, given that DoD now looks to international armament cooperative programs as the first option for future weapon systems acquisition strategies. Finally, the paper will identify barriers that are "hard-wired" into our acquisition regulations, policies, and statutes that restrict cooperation and are antithetical to our coalition goals as outlined in the U.S. national security strategy. The paper concludes with conditions that portend favorable international cooperative outcomes and recommendations for acquisition professionals, government lawmakers and policy makers for the U.S. to take full-advantage of the international cooperative approach and align our laws, regulations, and policies with our national security stated objectives.

The JSF international model will be evaluated using criteria from three dimensions:

political, strategic, and business-case. These were chosen on the basis of the principal stakeholders in the defense acquisition system; the political (Congress and partners), the warfighters (Combatant Commanders), and the business managers (acquisition professionals). The author has made extensive use of literature reviews from books, journals, newspaper articles, and interviews with industry experts, acquisition professionals, warfighters and other government agency officials. The JSF is used

throughout the paper as the predominant case study but other international programs were analyzed to provide a comprehensive review.

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## **Chapter 2**

# **Joint Strike Fighter Program**

I believe that national security - ours and that of our friends and allies - now, and in the future, will increasingly rely on bi- and multi-lateral armaments cooperation. The underpinning for this will be a shift towards giving greater importance to the economic and industrial considerations of material acquisition programs in the future. This belief is the basis for the renaissance in armaments cooperation occurring on both sides of the Atlantic.

Under Secretary of Defense (Acquisition and Technology) Paul Kaminski, 1996<sup>3</sup>

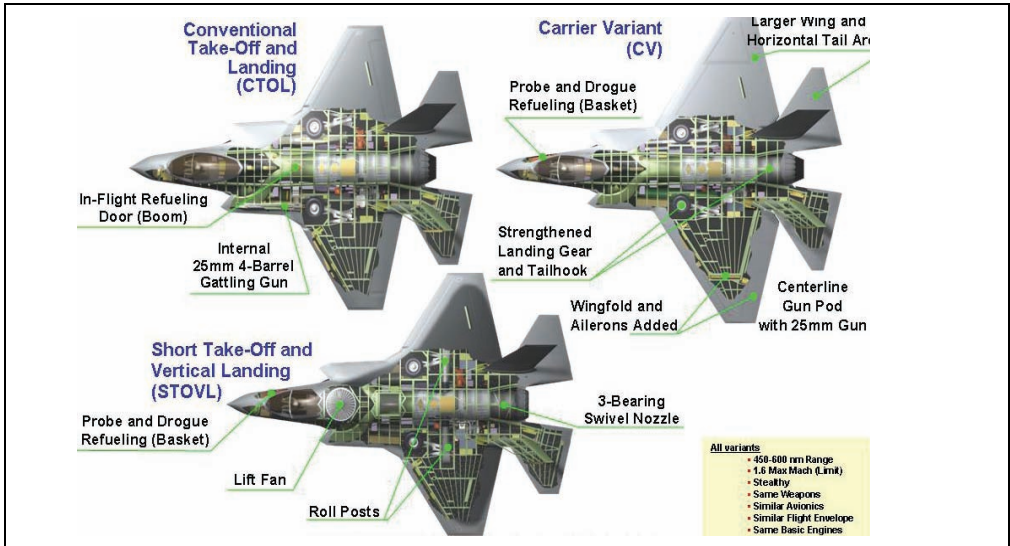
## **JSF Background**

### **History**

In 1993, with the incoming Clinton administration and the changing national security environment created by the end of the Cold War, DoD initiated a review<sup>4</sup> to address a balance among budget priorities, national military strategy, and future force structure. Over the subsequent 15 years, the services had planned to develop four tactical aircraft: the F-22 to replace the F-15, the Multi-Role Fighter as an F-16 replacement, the F-18E/F to replace the aging F-18C models, and an Advanced Fighter Aircraft. In addition, the Marine Corps had launched an advanced short take-off and vertical landing study with the Defense Advanced Research Projects Agency. The review determined all four programs, and the study, could not be supported within the future DoD budget. The DoD subsequently cancelled the Multi-Role Fighter and Advanced Fighter Aircraft. Recognizing the capability gap, however, the Secretary of Defense directed establishment of the Joint Advanced Strike Technology program in July 1993 to incorporate the Air Force and the Navy programs.<sup>5</sup> Congress later directed the Marine Corps study also be merged into the new program.<sup>6</sup> Thus began the predecessor study that would later lead to the JSF program.

## **Program Overview**

The JSF, at \$200B,<sup>7</sup> is the largest acquisition program in DoD history. The DoD views the JSF as a model for 21<sup>st</sup> century acquisition, promising three-planes-in-one jointness, low-risk development, and an unprecedented acquisition strategy through its international cooperative approach. The program seeks to produce three aircraft variants to satisfy the individual service requirements to replace four aircraft (F-16, A-10, F/A-18, and AV-8B). Additionally, international partners are seeking to replace eight different aircraft of their own. The three variants are: the Air Force Conventional Take Off and Landing (CTOL), the Navy Carrier Variant (CV), and the Marine Corps Short Take Off and Vertical Landing (STOVL). All are designed with a high degree of commonality (80% goal), greatly reducing non-recurring engineering and follow-on logistical and sustainment costs. During the Concept Development phase, requirements were developed along side the United Kingdom (UK). The UK was also part of the source selection team that selected Lockheed-Martin over Boeing in October of 2001, thus kicking off the \$30B<sup>8</sup> System Development and Demonstration phase. In addition to the UK, six other NATO countries joined the partnership: Denmark, Norway, the Netherlands, Italy, Canada, and Turkey. Australia, an ANZUS treaty country, was the last partner to join. The services are planning Initial Operational Capability in 2012 for the USMC and 2013 for the Air Force and Navy. Partners may begin taking delivery as early as 2014. Lockheed-Martin is the prime contractor partnering with Northrop-Grumman and British Aerospace (BAe). Additionally, the U.S. government has separate engine contracts with Pratt & Whitney and GE/Rolls Royce.



**Figure 1. JSF Variants**

## **International Partnership Strategy**

Partnerships are a relationship in which two or more nations attempt to engage in what they perceive as mutually beneficial activity through actions and policies.<sup>9</sup> The JSF international acquisition strategy is a complex set of relationships between government and industries of the U.S. and the eight international partners. The U.S. hopes to benefit by sharing program development costs and profits from international sales. The partners desire to improve capabilities and interoperability with the U.S. and NATO but primarily anticipate a significant benefit from the industrial participation throughout the development, production, and sustainment phases of the program.

Following the signing of the Memorandum of Understanding (MOU) and the JSF Framework MOU with associated supplements, each partner signed as a tier one, two, or three partner. Partnership tiering, defined by the level of financial commitment each country makes to the system development and demonstration phase, comes with commensurate benefits. The UK, as a tier I partner, will be the first to pick its delivery schedule. Additionally, tiers define the level of insight into the design and development process. For example, for \$2B, the UK is allowed 30 cooperative program personnel during the system development and demonstration phase of the program. As a tier II partner, the Italians, however, are only allowed 10 representatives in the program office and

have little influence on the capabilities except for their identified capability gaps in their ‘delta’ System Development and Demonstration version of the aircraft<sup>10</sup> (see Table 1). The international representatives are dual-hatted, working for the US program director and their respective MoDs. They attend program reviews but are not allowed access to non-disclosure related content as defined by the National Disclosure Policy. Partner tiers also do not determine the level of industrial participation. Work share is defined as the percentage of industrial participation each partner secures. It is the holy grail of international cooperative programs and, by far, its most acrimonious component.

JSF’s work share determination is quite revolutionary and therefore useful to analyze. In the European Fighter Aircraft program between the UK, Germany, Italy, and Spain, each partner country secured work share on the basis of the number of aircraft they were purchasing. For example, if the UK was planning on buying 20 percent of the production run, UK companies would receive 20 percent of the work share. The JSF program, however, adopted a different and highly controversial approach based upon “best value” or “best athlete.” All sub-contractor industries, regardless of country, were to compete on a best value basis—a combination of performance and price. The three U.S. prime contractors, Lockheed-Martin, Northrop-Grumman, and Pratt & Whitney, were responsible under the terms of their contracts, to ensure the playing field remained level for prospective U.S. and foreign subcontractors. “There will be no predetermined work share on JSF, no cozy *juste retour* arrangements for foreign partners signing up behind the programme.”<sup>11</sup> JSF is about affordability, says Lockheed Martin’s deputy program manager, so “the U.S. is casting its net worldwide to find companies with specialized expertise to help keep costs down.”<sup>12</sup> This approach has its benefits and liabilities, which will be addressed later in the paper. At this writing, however, all nine countries had industries on contract<sup>13</sup> and all will more than recoup their initial investment.<sup>14</sup> Italy, for example, will build 50% of all wings, and the UK will manufacture the aft fuselage and horizontal stabilizers.<sup>15</sup>

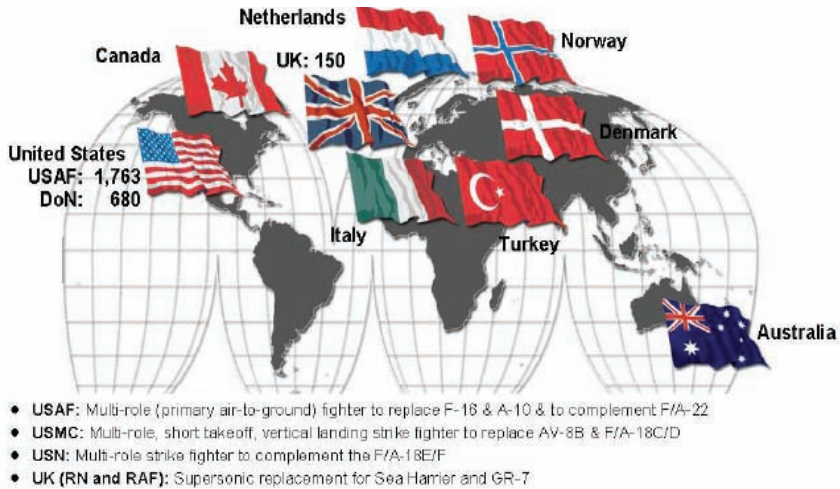


Figure 2. JSF Partners and Committed Buy

USAF: Multi-role (primarily air-to-ground) fighter to replace F-16 & A-10 & to complement F-22A  
 USMC: Multi-role, short takeoff, vertical landing strike fighter to replace AV-8B & F/A-18C/D  
 USN: Multi-role strike fighter to complement the F/A-18E/F  
 UK (RN and RAF): Supersonic replacement for Sea Harrier and GR-7

Country	Tier	SDD Contribution	SDD MOU date	Treaty	CPPs	Major Industry participation
UK	1	\$2.0B	17 Jan 2001	NATO	30	BAE, aft fuselage
Netherlands	2	\$0.8B	17 Jun 2002	NATO	4	Stork, panels/doors
Italy	2	\$1.0B	24 Jun 2002	NATO	6	Alenia, wings
Canada	3	\$0.150B	7 Feb 2002	NATO	2	Moog, actuators
Denmark	3	\$0.125B	28 Feb 2002	NATO	1	Parts
Turkey	3	\$0.175B	11 Jun 2002	NATO	2	TAI, composite parts, engine parts
Norway	3	\$0.125B	20 Jun 2002	NATO	2	Volvo, engine parts
Australia	3	\$0.150B	31 Oct 2002	ANZUS	3	Parts

Table 1. JSF Partner Major Work Share and Contributions<sup>16</sup>

Work share is among the major advantages to the partners in the program and is viewed as critical to their participation. Eight nations have cumulatively contributed \$4.5B dollars to participate in these expected benefits. Each nation, in addition to the U.S., also has stakeholders in the process who must be satisfied. Identifying these stakeholders and their interests is critical to successful international programs.



## Setting up the Problem

According to George E. Hudson, the following conditions generate successful cooperative programs:

1. The existence of complementary interests between or among the nations;
2. The pressure of politically important domestic audiences to pursue a cooperative relationship;
3. A national security and/or foreign policy basis that can incorporate cooperation with the other party or parties involved.<sup>17</sup>

Goals and expectations of each party are also important to the probable outcomes of the cooperative relationships:

1. Increased economic benefits;
2. Improvement of military power on either a regional or global basis;
3. Enhancement of regional or global stability;
4. Assistance in gaining an advantage over a specific competitor in the international system or at least deterring the activity of a potential or actual competitor.<sup>18</sup>

Others, who have studied IACP histories, have compiled very similar lists. The Manual for Security Assistance lists the following advantages:

1. Operational—to increase military effectiveness through interoperability with allies and coalition partners;
2. Economic—to reduce weapons acquisition cost by sharing costs or avoiding duplication of development efforts with our allies and friends;
3. Technical—to access the best defense technology and help minimize the capabilities gap with allies and coalition partners;
4. Political—strengthen alliances and relationships with other friendly countries, and;
5. Industrial—bolster domestic and allied defense industrial bases.<sup>19</sup>

A useful paradigm to view this complex international environment is through the lens of stakeholders, specifically, their interests, responsibilities, and risks. The common stakeholders in any acquisition program, and who also nicely coincide with the lists above, are the following:

1. Those who hold the purse strings—Congress and the respective partner parliaments);

2. Those who will use the weapons in anger—the warfighters (COCOMs/partner MoDs);
3. Those who will determine the requirements, develop the systems, perform follow-on tests, tactics, techniques, procedures and training—the services;
4. Those responsible for all program objectives—the Program Office, and;
5. Those who will actually perform the work—the prime contractor (Lockheed-Martin) and their subcontractors.

Congress is interested in minimizing outlays by sharing both costs and risks of the program development with the international partners; this of course is juxtaposed with the risk of transferring crucial program data that may invigorate industrial competitors. The warfighter is interested in increasing the capabilities and interoperability of their forces along with that of their allies without revealing vulnerabilities or the risk of critical technologies falling into the hands of their adversaries. The service's desires are equivalent to the Combatant Commanders except they have the additional risk of cost since they are footing the bill. The program manager is interested that all program objectives are met—cost, schedule, and performance. Lockheed-Martin, and their subcontractors, is concerned with the same but does not share as much of the risk since the services have assumed most through the cost-plus contract. The contractor's major concern is that of its stockholders—return on investment. The partners are interested in capabilities and interoperability, but their primary interest is industrial work share and technology transfer. Lockheed-Martin must bear the burden of responsibility for managing partner expectations in this regard. This area is arguably the most sensitive and difficult to manage. Under the work share arrangement, Lockheed-Martin must keep the playing field level with regard to competition. Best value sounds great, but if the partners do not secure what they consider to be a fair share of the contracts, they may defect from the program thereby increasing the risks and costs to the remaining partners. Currently, at least one of the partners are considering reduced scope or program pullout by the production and sustainment MOU signing because of work share. This is the greatest danger to international cooperative programs, and Europe is replete with examples. Therefore, Lockheed-Martin has its work cut out and must play both sides of the ball in addition to being the referee.

Stakeholders	Interests	Responsibilities	Risks
<b>Congress</b>	<ul style="list-style-type: none"> <li>- Shared costs and risk</li> </ul>	<ul style="list-style-type: none"> <li>- Authorization and appropriation of funds</li> </ul>	<ul style="list-style-type: none"> <li>- Cost overruns</li> <li>- Inordinate Tech Transfer</li> </ul>
<b>COCOMs</b>	<ul style="list-style-type: none"> <li>- U.S./Coalition Capabilities</li> <li>- Interoperability</li> </ul>	<ul style="list-style-type: none"> <li>- Requirements</li> <li>- Recommend coalition capabilities</li> </ul>	<ul style="list-style-type: none"> <li>- Rogue nations that obtain high tech capabilities</li> </ul>
<b>Services</b>	<ul style="list-style-type: none"> <li>- Capabilities</li> <li>- Interoperability</li> <li>- Costs</li> </ul>	<ul style="list-style-type: none"> <li>- POM, advocate, organize, train, equip</li> </ul>	<ul style="list-style-type: none"> <li>- Cost overruns</li> <li>- Vanishing international vendors</li> </ul>
<b>Program Mgr</b>	<ul style="list-style-type: none"> <li>- Cost, Schedule, Performance</li> </ul>	<ul style="list-style-type: none"> <li>- Program Objectives</li> <li>- Key Performance Parameters</li> </ul>	<ul style="list-style-type: none"> <li>- Cost overruns</li> <li>- Defecting partners</li> </ul>
<b>Partners</b>	<ul style="list-style-type: none"> <li>- Capabilities</li> <li>- Interoperability</li> <li>- Tech Transfer</li> <li>- Work share</li> </ul>	<ul style="list-style-type: none"> <li>- Monetary contributions</li> <li>- Define requirements</li> </ul>	<ul style="list-style-type: none"> <li>- Initial Investment</li> <li>- Arms (parts) embargo if relationship deteriorates</li> <li>- Not securing work share</li> </ul>
<b>Prime Contr.</b>	<ul style="list-style-type: none"> <li>- Cost, schedule, performance</li> <li>- Key Performance Parameters</li> </ul>	<ul style="list-style-type: none"> <li>- ROI</li> <li>- Manage partner expectations</li> <li>- Equitable work share within rule set</li> </ul>	<ul style="list-style-type: none"> <li>- Initial investment</li> <li>- Defecting partners</li> </ul>

**Table 2. Stakeholders, Interests, Responsibilities, and Risks**

Table 2 describes interests, responsibilities, and risks of the various stakeholders. The next chapter will analyze the benefits of international cooperative programs across the three stakeholder dimensions: political, strategic, and business case.

## **Chapter 3**

# **Benefits of International Armament Cooperative Programs**

The core objectives of armament cooperation for programs like JSF are to increase military effectiveness through standardization and interoperability, and to reduce weapon acquisition costs by avoiding duplication of development efforts with our allies. The United States will benefit from sharing JSF program costs, improving interoperability with key allies, gaining access to selected foreign industrial capabilities and increasing international sales potential. Our Joint Strike Fighter partners will benefit from cooperatively developing and acquiring an affordable next generation strike fighter weapons capability, participating in the day to day management of the program and building long-term Industrial relationships with US. aerospace companies.

Mr. Alfred G. Volkman, Director for International Cooperation,  
OUSD(AT&L)

Partnership benefits can be enjoyed in non-common areas with one party seeing economic gains while the other benefits politically.<sup>20</sup> Said another way, international cooperative programs may not always be the most cost-effective means to acquire a new weapon system—other considerations may prevail. For example, from a political-military perspective, international cooperative programs may pay tremendous dividends in foreign relations, regional stability, future coalition opportunities, and help bolster a healthy and vibrant defense industrial base. Such a strategic view must be considered when assessing their efficacy. This chapter analyzes the benefits to the three major dimensions: political, strategic, and business case.

## **Political Analysis**

### **Strengthens Alliances**

Our National Security Strategy hinges upon the cooperation of our allies and friends:

There is little of lasting consequence that the United States can accomplish in the world without the sustained cooperation of its allies and friends in Canada and Europe. Europe is also the seat of two of the strongest and most able international institutions in the world: the North Atlantic Treaty Organization (NATO), which has, since its inception, been the fulcrum of transatlantic and inter-European security, and the European Union (EU), our partner in opening world trade.<sup>21</sup>

There is an inevitable “nexus”<sup>22</sup> among trade, investment partners, and our military allies. The U.S. strategy recognizes this nexus and outlines a number of objectives to achieve the above:

1. Ensure that the military forces of NATO nations have appropriate combat contributions to make in coalition warfare;
2. Take advantage of the technological opportunities and economies of scale in our defense spending to transform NATO military forces so that they dominate potential aggressors and diminish our vulnerabilities;
3. Streamline and increase the flexibility of command structures to meet new operational demands and the associated requirements of training, integrating, and experimenting with new force configurations; and
4. Maintain the ability to work and fight together as allies even as we take the necessary steps to transform and modernize our forces.<sup>23</sup>

The National Defense Strategy says we must increase our coalition partner capabilities and our strategic objectives are not attainable without these partners.<sup>24</sup> Rear Admiral Enewold, the JSF Program Director, relates:

When we start operating JSF together I think we will lock our partners into the coalition much tighter. I think the partners will be much better prepared to operate in the coalition, much more comfortable because of the

connectivity we will have, will be much more capable, and the capabilities gap will close significantly so they can go after some of the harder stuff...by virtue of getting the same hardware and compatibility at a significant level which is not there right now. And the COCOMs are going to be more agreeable to tasking them because they will have the capabilities to do it. Presently, they're not going to send a [coalition] Block 30 F-16 [into a high threat area] to go get whacked.<sup>25</sup>

Past cooperative programs have produced long-term relationships that paid dividends throughout the sustainment period of the systems developed and purchased by the respective partners. Indeed, these programs are extremely important to allies. Colonel Michael Williams, former F-16 Systems Program Office director and current Wing Commander for Fighter and Attack Aircraft at the Aeronautical Systems Center, stated:

...it's all about building relationships...often with [collaborative programs] it is very important for these countries to believe they are equal partners with the United States. The original F-16 EPAF nations [Denmark, Norway, Netherlands, Belgium, and Portugal] believed they were partners because of the F-16...this was not a NATO thing.<sup>26</sup>

Buying fighters can be compared to a consumer buying a car; sometimes emotions win the day.

International cooperation history abounds with countries making financial decisions that appear on the surface as foolhardy. National pride and political motivations often prevail over fiscal responsibility. Finland spent 50% of its defense budget on the F/A-18.<sup>27</sup> The Japanese developed the F-2 fighter with General Dynamics, the original producer of the F-16, even though they ended up with an F-16 like capability at three times the cost of an F-15.<sup>28</sup> Turkey, in the 1983 Peace Onyx I co-production agreement, produced 160 F-16's for \$4.16B U.S. dollars. This does not seem exorbitant until one considers it was twice the Turks' entire defense budget for that year. The Turks knew that co-producing the aircraft was likely to increase the unit cost by millions per unit but they considered the additional cost worth the prestige and potential return on investment for their defense industry.<sup>29</sup> They eventually hit pay dirt with the Peace Vector sales to Egypt (46 F-16s produced in Turkey in 1994-1995). The

U.S. had interests beyond the financial as well. In 1983 the U.S. strategists saw bolstering Turkey’s armed forces as an important hedge against the Soviet build-up.<sup>30</sup> In addition, the agreement provided the U.S. with basing rights across Turkey. This proved pivotal during the first Gulf War, enabling the U.S. to secure a northern and southern approach during the bombing campaign.<sup>31</sup> Often, however, economic realities demand a strong business case; cooperative programs can deliver in spades.

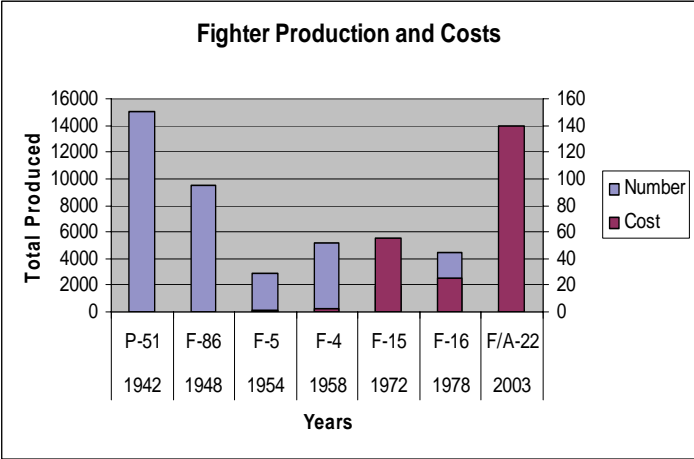
### **Reduces Acquisition Costs and Increases Market Share for US Industry**

DoD acquisition regulations acknowledge the benefits of international cooperation: “leveraging of U.S. resources through cost sharing and economies of scale afforded by international cooperative research, development, production, and logistics support programs should be fully considered when DoD components work with users to define needed capabilities as well as during the preparation of the technology development strategy and subsequent acquisition strategy.”<sup>32</sup> Why this emphasis on international participation? On average, DoD invests \$100 billion each year in a wide array of weapon systems; these range from tanks and fighter aircraft to sophisticated satellites. It is not unusual for a single program to cost over \$40 billion. The Government Accountability Office (GAO) estimates the F-22A will be \$70B. These investments often represent the largest discretionary portion of the U.S. budget.<sup>33</sup> Cost growths are not limited to major acquisition programs. The GAO recently studied 26 weapon systems, analyzing their cost growths based upon initial and latest estimates. On average, the programs suffered a 19.6% schedule slippage and a 14.5% acquisition cost increase (Table 3).

	First full estimate	Latest estimate	Percent change
Total cost	\$479.6M	\$548.9M	14.5%
RDT&E cost	\$102.0M	\$144.7M	41.9%
Weighted-average acquisition cycle times	146.6 months	175.3 months	19.6%

**Table 3. Cost and Cycle Time Growth for 26 Weapon Systems<sup>34</sup>**

The soaring costs have resulted in significantly reduced unit buys compared to previous eras. In 1951 the US procured a total of 6,300 fighter aircraft (Air Force and Navy) at a cost of \$7B (1983 dollars). In 1999 the U.S. programmed for 95% fewer fighters (322) at \$11B.<sup>35</sup> This trend started years earlier. In the 1940s the US produced 15,386 P-51 fighters over a 5-year period. The economies of scale realized were remarkable; each P-51 cost a mere \$55,000 (then year dollars); but over the decades, due to increased effectiveness of weapon systems, shrinking discretionary acquisition funds, and acquisition program cost overruns, unit buys have significantly decreased. As unit buys decreased, unit costs skyrocketed. For example, in the 1980s the Air Force purchased 100 B-1B bombers at a relative cost of more than its weight in silver.<sup>36</sup> In the 1990s the B-2 bomber, with 21 aircraft procured, cost more than its weight in gold.<sup>37</sup> Now, in the 21<sup>st</sup> century, the F-22A, at 183 aircraft, will be more than four times its weight in platinum.<sup>38</sup>



**Figure 3. Historical Fighter Production and Unit Costs**

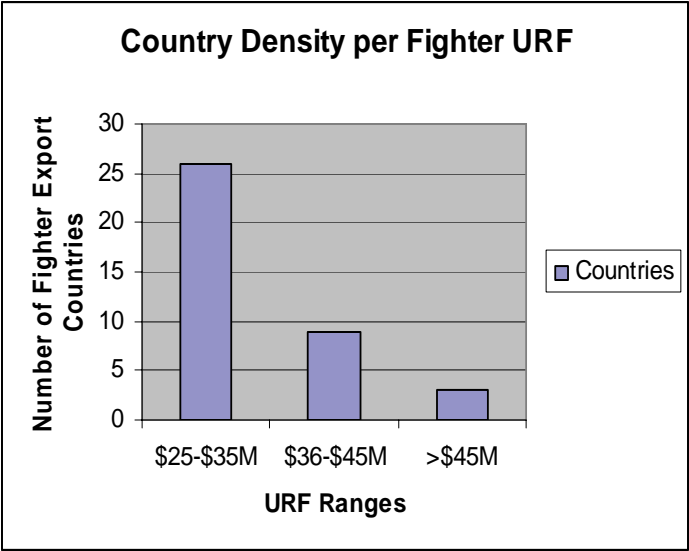
Such realities prompted Norm Augustine, former CEO of Martin Marietta Corp and later Lockheed-Martin, to predict lightheartedly that at this rate, in 2054, the entire DoD defense budget will only be able to afford one tactical fighter.<sup>39</sup>

### Breakdown of the JSF Numbers

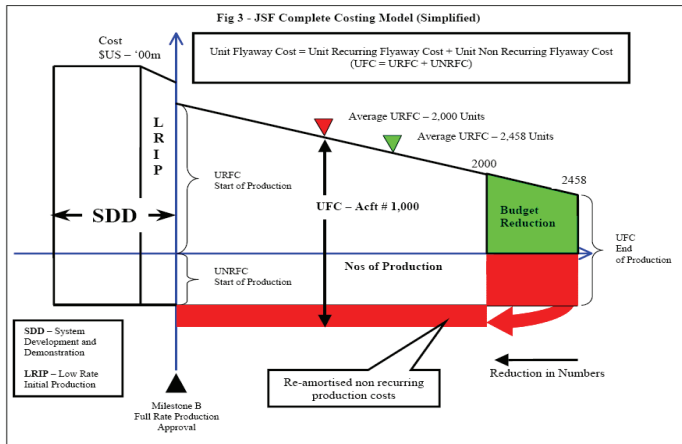
The U.S. is currently programming for 2,457 F-35 aircraft. This breaks down to 1763 CTOL (Air Force) and 680 CV/STOVL for the Department of the Navy. The UK has agreed to purchase 150 STOVL aircraft, bringing the total aircraft buy to 2607 aircraft. The additional 14



aircraft are for test. Other partner and Foreign Military Sales numbers are estimated at greater than 2000 aircraft. Such a production run, if realized, would rival the F-16. The total buy is critical to maintaining the proposed Unit Recurring Fly-away (URF) costs of \$40M for the Air Force variant and \$45-50M for the Navy and Marine Corps.<sup>40</sup> The importance of a large production buy, reducing unit cost, is underscored by the importance of the number. If the F-35's cost increases beyond a certain point, much of its competitive advantage will be eroded because the defense market is very cost-sensitive. For example, in the past two decades, there have been 26 export customers for fighters in the \$25-million-\$35-million range (F-16, Mirage 2000, Gripen, and Harrier). There have been nine export customers for fighters in the \$36-million-\$45-million range (F/A-18A/B/C/D, and Su-27/30). Notably, however, there have been a mere three export customers for fighters in the \$45-million-and-above range (F-15, and Tornado).<sup>41</sup> The JSF, at \$40M-\$50M, is right at the knee in the curve. A majority of escalating program costs is due to a reduction in the total buy of the aircraft. The F-22A is a prime example. Under the elder Bush administration, the buy was 750; by the end of his administration, the buy had been reduced to 648. During the Clinton administration, the buy was further reduced to 339. Under the current Bush administration, the buy has been reduced twice from 279 to 183.<sup>42</sup>



**Figure 4. Number of Fighter Foreign Customers per Unit Recurring Fly-away Costs**



**Figure 5. Notional JSF Average Unit Recurring Fly-away Costs as a Function of Buy<sup>43</sup>**

Without a large production buy, JSF will go the way of the F-22A, which is now estimated to cost \$70B. If one includes development and procurement, this translates to \$383M per aircraft.<sup>44</sup> Total sales do more than just reduce the average unit cost; they also keep the industrial base invigorated for years.

### **Bolsters Domestic and Allied Industrial Bases**

In the aftermath of the Cold War, defense budgets shrank, industries merged, and collaboration between aircraft manufacturers became increasingly important. In 1985, US defense-related production accounted for 3.7M jobs; just a decade later it eroded to only 2.4M jobs—a 35% decrease. In 1993 there were 20 U.S. companies doing major defense work. Today there are five.<sup>45</sup> Only three of these companies build aircraft for the DoD (Boeing, Lockheed-Martin, and Northrop-Grumman). Then Undersecretary of Defense William Perry called the now famous “last supper,” where he urged the remaining defense industry CEOs to consolidate through vertical and horizontal integration in light of the coming defense downturn.<sup>46</sup> The purpose of the proposed consolidation was to reduce the U.S. defense asset base in both commercial and government sectors by over 40%.<sup>47</sup> If assets were not reduced, declining defense dollars would mean unit costs would rise, ultimately affecting

profit margins. If returns on investments declined, defense aerospace industries, essential to a strong defense infrastructure, could collapse. This was clearly not in the best interest of the U.S.,<sup>48</sup> but the unintended consequence of consolidation was reduced competition.

The DoD must appropriate the reality that the U.S. is in a fundamentally different acquisition environment today than 20 years ago. In 1985, DoD had multiple new-starts and large annual production runs (585 aircraft, 2,031 vehicles, 24 ships, 32, 714 missiles).<sup>49</sup> Today, new starts have slowed to a trickle and production rates have plummeted (188 aircraft, 190 vehicles, 8 ships/subs, 5,702 missiles).<sup>50</sup> There are two solutions to this problem: create a subsidized (and expensive) design bureau (as in the former Soviet model and similar to our ship building industry) or secure additional markets through international participation. "In the era of globalization, United States defense companies can no longer rely on their home market any more and need to secure an increasing share of international markets to maintain their revenues, profits and share prices."<sup>51</sup> Even the skeptical Defense Science Board report, mentioned earlier, concluded that the JSF should design to the export market, saying it can significantly contribute to the overall success of the program and that some level of participation during development may be required to secure foreign markets.<sup>52</sup>

To some extent this is happening, unfortunately namely across the Atlantic. Europe came to this reality long before the U.S. and has been building fighters using the partnership model for over 30 years.<sup>53</sup> Rarely does a country in Europe venture out and develop any weapon system on its own. Those who have, (French Rafael fighter), have suffered significant losses because they were unable to purchase enough aircraft to cover development overhead. Moreover, because they have developed the weapon system indigenously, they did not secure foreign markets. Boris Yeltsin recognized that the Russian defense system could no longer prop up the old communist defense industry. Under Yeltsin, the Russians increased their export of military equipment by over 42 fold compared to the Gorbachev years (1985-1991). Yeltsin stated in 1992, "[t]he weapons trade is essential for us to obtain the foreign currency which we urgently need to keep the defense industry afloat."<sup>54</sup> Diversity is of course important in this regard; today the Russian industry is almost completely dependent on Beijing for survival, giving the Chinese unusual access to Russian technologies and arms.<sup>55</sup> International cooperation in the defense industry has flourished overseas because of intensifying competition for global markets, rising development costs, rapid obsolescence of new products, and considerable uncertainties and risks regarding performance,

schedules, and market size.<sup>56</sup> The bottom-line message is this: the U.S. defense market is no longer sufficient to maintain its own industrial base and this is true in spades for the fighter market. When Lockheed Martin Aeronautics signed the latest Peace Marble contract with Israel for 52 additional F-16s in 2001, CEO Dain Hancock said,

This contract is very important to us for a number of reasons, it completes the deal for a very important customer, it extends the firm F-16 production base through 2008 and it boosts our firm orders for 2001. This buy provides an excellent base for future F-16 sales and provides a solid bridge to JSF production at our Fort Worth facility.<sup>57</sup>

Another more recent example is the sale of F-16 Block 60 aircraft to the United Arab Emirates. This \$6.7B agreement competed directly with the French Rafael. Such international agreements have sustained the F-16 production line for 26 years, which reached its U.S. production peak of 25 aircraft per month in the late 1980s. Only in 2003 did the line start seeing reductions and, due to the Block 60 sale to U.A.E., the line will not shut down until late in the decade.<sup>58</sup> In all, close to 5000 F-16s will have been produced, making it one of the most successful fighter programs in history. Such a feat would not be possible were it not for international sales secured by international markets. JSF international sales portend increased market share to U.S. and partner industries while taking share away from European competitors such as the French Dassault Rafael, European Eurofighter, and the Saab-BAe Systems Gripen. Richard Aboulafia, a U.S.-based industry analyst with the Teal Group, was blunt when asked for his assessment of the F-35: “[i]t could do to the European fighter industry what the F-16 almost did—kill it.”<sup>59</sup> Curiously, two of the JSF partners, the UK and Italy, became partners after their commitments to the Eurofighter program. Such a reality brings serious doubt into the efficacy of the European Fighter Aircraft Foreign Military Sales program.

The key to strengthening alliances is perceived benefits by all stakeholders. Congress benefits because more sales mean more jobs in their districts. The services benefit because of lower unit costs. Partners benefit because, by purchasing the JSF, they have greater incentive marketing the aircraft elsewhere for reasons of investment recoupment, return levies from non-partner sales, and larger incremental revenues for their participating companies.<sup>60</sup> There are several benefits that these provide to international participants. Among them are production technology transfer and the ability of the country to relatively

inexpensively acquire high-tech weapon systems without paying high-premiums for development. For example, when a country purchases an aircraft through the Foreign Military Sales (FMS) process, a 1.7% processing fee is normally attached along with a stipend to cover costs associated with security assistance, non-recurring engineering, development, and production. This can add millions of dollars to the unit recurring fly-away costs. Conversely, participating partner countries do not pay for non-recurring engineering and portions of the R&D as they would for Foreign Military Sales programs. They may even benefit from reimbursements from other countries that later purchase the end item under a Foreign Military Sales agreement, defraying some of their costs.<sup>61</sup> The Netherlands identified the JSF program as one of the two pillars upon which it expected to build a world-class aerospace industry. Danish industry was so impressed by the opportunities that they invested, along with the Danish government, in the system development and demonstration phase. Major Italian companies are sending around 100 of their engineers to be part of six Lockheed integrated product teams in Fort Worth and El Segundo, along with Danish engineers. Australia established integrated teams to parallel Lockheed's teams for maximum program productivity. Such involvement of partner industry is unprecedented in any previous U.S. led international venture and underscores the benefits each partner expects to derive.<sup>62</sup>

Strategic leaders see cooperative programs as a grand strategy for improving international relations. When the U.S. sells or co-develops a weapon system with a trusted ally, they cement relationships far beyond the performance period of an acquisition program. The relationship is maintained throughout sustainment, a period normally exceeding 30 years. Such is particularly important with traditional allies, like Australia, whose relationships with the U.S. may be based more upon history than current benefits.

Australia has been a trusted ally for over 60 years, fighting along side the U.S. in almost every conflict since 1941. Recently, however, this country has developed a mutually beneficial trade relationship with China. Indeed, Australians live closer to Southeast Asia than to the U.S. China and Australia rely heavily upon each other for international trade. China's growing demand for energy resources places Australia near the top of its list for their plentiful natural gas resources. It is not out of the question then that, should the U.S. and China have a falling out, Australia may have to seriously consider who butters its bread. If the relationship is based more upon history than future long-term opportunities, the decision may be a difficult one. If the U.S. establishes long-term financial interests

with Australia through the JSF, then it will have more to rest on than just their common history or past laurels. Along with political considerations comes the all-important question of how does an international program benefit the only real customer—those at the pointy end of the spear?

## **Strategic Analysis**

### **Coalitions Provide Access and Credibility**

The United States cannot influence that which it cannot reach.<sup>63</sup> Turkish Admiral Sezai Orkunt, a former staff planner, once remarked:

Countries accepting military assistance should be prepared to allow the use of military bases in their territory to countries providing assistance. Such assistance will include advanced weapons systems only in exchange for the highest assurances on their use. Great powers have dealt and continue to deal to this day on these terms. The receiving side is obligated to bring to the negotiations an offer in some form to provide bases on its soil, to host foreign troops, or better to arrange for joint bases and operation organizations along the country's territorial borders.<sup>64</sup>

In today's international environment, access to some regions can only be achieved through previous relationships forged with international cooperative programs or security assistance.

General Chuck Horner, Gulf War I Joint Air Component Commander, stated after the war:

Desert Storm was an international team effort. It couldn't have worked as well as it did—or maybe even worked at all—if all the nations hadn't cooperated, paid respect to one another, and shouldered equal portions of the burden. This was not an American war. It was a Coalition war. And we'd better remember how we did it if we're to be successful in the wars of the future.<sup>65</sup> “[O]ur combined efforts gain legitimacy because they come for many nations, not just one. Therefore, we need to prepare in peacetime to undertake combined operations during a crisis.<sup>66</sup>

General Horner notes that coalition partners provide three main benefits: bases and ports for access; soldiers, sailors, and airmen, and; counsel and

legitimacy. Beyond credibility and counsel, increasing the capabilities of our allies brings effectiveness in coalition warfare by closing the widening capabilities gap.

### **Increases Coalition Capability**

The Secretary of Defense's second priority is to "strengthen combined/joint warfighting capabilities."<sup>67</sup> Regarding coalition capabilities, the current National Defense Strategy states:

Our strategic objectives are not attainable without the support and assistance of capable partners at home and abroad...encouraging partners to increase their capability and willingness to operate in coalition with our forces...Spurring the military transformation of key allies through development of a common security assessment and joint, combined training and education; combined concept development and experimentation; information sharing; and combined command and control.<sup>68</sup>

Why is this important? The U.S. is not likely to fight without partners in the foreseeable future. Regrettably, there is a growing capabilities gap between the U.S. and its allies.

During the first Gulf War, the U.S. fashioned together an impressive coalition to help evict Saddam Hussein from Kuwait. When it came time to incorporate the lagging coalition capabilities into a cogent Air Tasking Order (ATO), however, planners found they could only assign meaningful tasks to the UK and a few other NATO countries. Coalition warfare capabilities planning, for all intents and purposes, was a deconfliction exercise. None of the coalition partners were capable of deep strike, due to lack of stealth. No other country was capable of dropping precision-guided munitions, none could perform the important role of suppression of enemy air defenses (SEAD), and only a few could perform adequate offensive counter air (OCA) missions. Where capability was lacking, interoperability and training lacked even more. Many coalition air assets were relegated to small grids (designed to keep them from becoming a friendly fire casualties).

Almost a decade later, things hadn't improved. Operation Allied Force consisted almost entirely of air operations. Of the 19 NATO nations, four did not even participate because they lacked relevant capabilities. Though the remaining flew 15,000 sorties, or 39% of the total, the U.S. delivered 80% of the ordnance.<sup>69</sup> Many capabilities such as electronic warfare, all weather precision-guided munitions, aerial

refueling, airborne command and control, and suppression of enemy air defenses were accomplished almost completely by the U.S.<sup>70</sup>—and this was in NATO’s backyard.

Why has the U.S found it so difficult to increase the capabilities of its allies? The reasons are money and the fact that doing so often invites the ire of those concerned about technology and capability transfer. It is customary for DoD to charter a ‘Red Team’ to investigate the dangers of exporting critical technologies and capabilities. Seeking to counter what they viewed as a traditionally protectionist approach, the JSF Joint Program Office (JPO) asked that a ‘Blue Team’ look at the advantages of exporting critical capabilities. The joint staff chartered the team and tasked them interview the Combatant Commanders to determine what JSF capabilities they desired for their regional coalition partners.<sup>71</sup>

The Blue Team went to the regional commanders where JSFs were likely to be sold either through the partnership or later Foreign Military Sales.<sup>72</sup> Instead of showing the Combatant Commanders a list of technologies, however, they were shown a list of capabilities that JSF could bring to the fight if sold to their regional allies: strategic attack, close air support, air interdiction, suppression of enemy air defenses, destruction of enemy air defenses, cruise-missile defense, and interoperability. The greatest concern of the commanders was that their partners were not interoperable and not capable of materially contributing to the fight. All the Combatant Commanders desired to give their coalition partners most of the capabilities. They wanted to avoid the capabilities gap seen in the first Gulf War, and later Bosnia and Kosovo. In each of these cases, when it came time to fill out the Air Tasking Order, the allies were relegated to menial tasks and told to stay out of certain areas lest they become victims due to incompatibility of electronic identification capabilities. This caused planners to view coalition partners as simply “tickets to the dance,” with no corresponding value added. Moreover, coalition partners felt as if they were not appreciated. General Horner remarked after the Gulf War, “[t]he Arab coalition did not have the combat experience of Korea, Vietnam, and the Cold War. Thus they entered the fight as an equal partner who did not feel equal.” The JSF F-35, as the Combatant Commanders viewed it, would provide the “turn-key” solution to these woes.

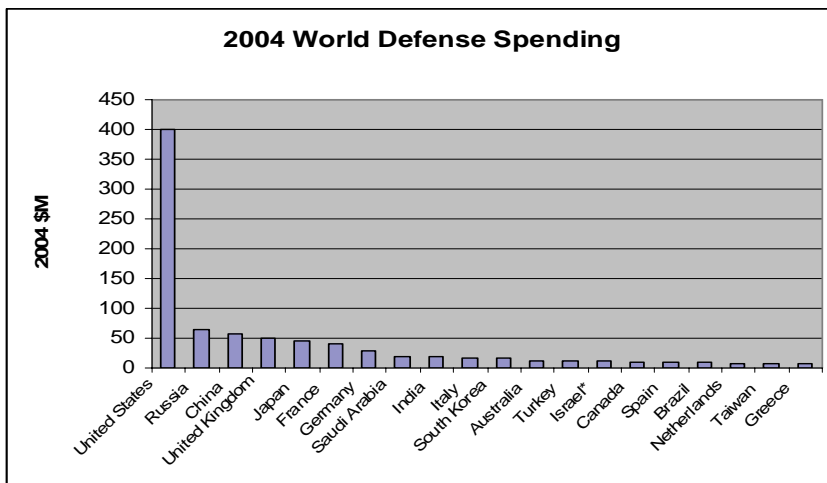
Lt General Michael C. Short (ret), former Joint Forces Air Component Commander (JFACC) during Operation Allied Force (OAF) in Kosovo, lamented that we had not paid the proper attention to the state of our allies. “Several wanted to come to the fight but did not possess capabilities that we could use, or often came to us asking for weapons



such as Laser Guided Bombs (LGB) because they could not afford any.” Asked how the JSF would contribute to a regional commander’s options, Gen Short said the JSF would bring both interoperability and capability, thereby significantly increasing the Combatant Commander’s options. He whole-heartedly supported the program for those reasons.<sup>73</sup> Lack of money is the second reason why coalition partners lag in capability and interoperability. International partnerships, in general, and JSF, in particular provide a relative solution to this as well.

### JSF Provides Coalition Partners with “Turn-Key” Solutions

The United States spends more on defense than 25 of the next closest nations. To put this in perspective, the poorest ten NATO nations spend less money on defense than Mexico. Coalition partners are becoming increasingly alarmed that they can no longer keep up with the U.S. in either quality of the technologies or quantity of the equipment. One international officer in the JSF program office remarked that his country could not afford HAVE QUICK radios, much less keep up with the U.S. on sophisticated weaponry, were it not for international cooperation. Interoperability became a

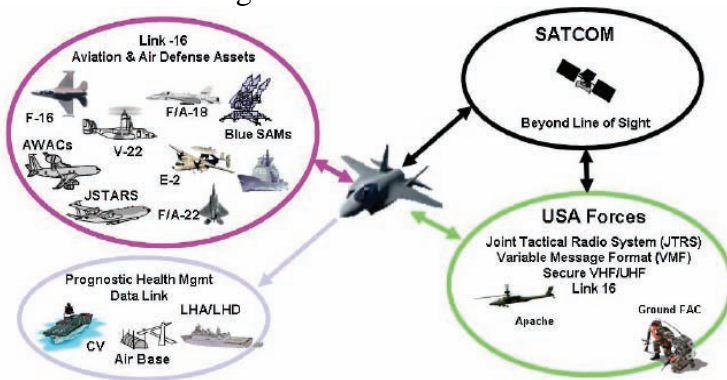


**Figure 6. 2004 World Defense Spending**

constant thorn in the coalition’s side during Desert Storm and Operation Allied Force. Most of the coalition forces lacked compatible communication equipment with each other. Those compatible lacked encryption. Consequently, command and control of aircraft had to be done ‘in the clear’ compromising operations security.<sup>74</sup>

The JSF, through its partnership approach, may be able to provide an economically achievable, interoperable solution for coalition partners. One of the key benefits of the JSF is the instant interoperability it provides. Interoperability is defined as systems, units, and forces providing and accepting data, information, materiel, and services to and from other systems, units, and forces effectively interoperating with other U.S. forces and coalition partners.<sup>75</sup>

The F-35 was designed with interoperability at the forefront, instead of as an add-on requirement. Consequently, the F-35 is a Command, Control, and Communication (C<sup>3</sup>) node in the sky, with over 120 information exchange requirements.<sup>76</sup> The aircraft is intended to be a network-centric fighter going beyond the traditional single-task capability.<sup>77</sup> Embedded in the architecture are interconnecting grids bringing together a bevy of on-board and off-board sensors. It is considered to be a ‘contributor’ rather than just a consumer of information. Because partner interoperability requirements were incorporated up front, each partner, by default, will be able to receive and contribute to the C4ISR grid.



**Figure 7. JSF Interoperability**

The F-35 sensor suite includes an impressive array of sensors—a Multi-Function Array (MFA), Advanced Electronic Sensors Suite, an Electro-Optical Tracking and Sensor (EOTS), and a Distributed Aperture System (DAS) consisting of multiple infrared sensors. In addition, it interfaces with off-board platforms such as the Joint Surveillance Target Attack Radar System (JSTARS) and the Airborne Warning and Control System (AWACS) or any other Link-16 compatible systems. After the political and strategic considerations are tallied, the JSF represents a compelling case. However, when acquiring the largest DoD weapon system in history, a strong business case is also necessary.

## **Business Case Analysis**

### **Increases Funding Stability**

Each year DoD must decide where it is going to get the money to pay for all its acquisition programs—there are always more programs than money. Those programs not executing well or cancelled are sources of some money, but in most years, this is not enough to cover the shortfalls. The OSD comptroller solves this problem by sending the services a bill. The services comply by ‘peanut butter spreading’ the cuts across all their programs. Unfortunately, cutting money from programs results in highly costly delays. Some studies suggest for every \$1 saved, an additional \$4 will be added in the out-years. The F-15 air superiority fighter is a prime example. Due to budget constraints, a substantial number of production aircraft were pushed three years to the right during the peak production period in order for the Air Force to pay for other shortfalls. The total number of aircraft remained constant at 729 but the bill to the Air Force in the out-years was \$2B. This amount could have been used to produce an additional wing of F-15s (72 aircraft).<sup>78</sup> Adding insult to injury, there was now \$2B less in the Air Force budget to fund future programs. This is a vicious cycle that unfortunately plays out in all programs not ‘fenced’ from the cuts.

Unlike most program managers, however, Rear Admiral Steven Enewold, JSF Director, has some protection from funding instability:

...people have the tendency not to tinker [re: cut budget] with us as much because the implications on the international side. DoD is pretty good at recognizing that State, and Commerce are affected...[While] Tony Blair doesn't call President Bush on JSF unique stuff, JSF still often comes up during bi-lateral talks. The Brits are very concerned with having an aircraft for their new carrier and are concerned that the program is moving forward...some people say it freezes us into immobility but it really gives us a measure of stability that I don't think any other program has.<sup>79</sup>

Financial flexibility—the ability to apply resources wherever needed and whenever needed—is also extremely important.

## **Partner Contributions Increase Program Managers' Flexibility**

International partner contributions are extremely important for a program manager, particularly during development, because they can be counted on to be there when promised, cannot be taken, and allow the program manager flexibility to apply across several areas without a lengthy Congressional approval process. Rear Admiral Enewold remarked:

There is certainly the financial benefit with the international partners contributing a significant amount of money. This year is a big year in terms of contributions and next year the partners will contribute over \$800M. [While] it has R&D restrictions analogous to the 3600 money in support of system demonstration and development...it does not expire. We try to spend the money in a timely manner because they have requirements like the U.S., but by the MOU, we can just spend it on other things. You can count on it and it can fill gaps that if for some reason you can do something that you don't have permission from Congress to do and if we convince ourselves it is good for the program, we can go to the partners and get approval.<sup>80</sup>

There are other advantages to partners, such as better ideas, approaches, and technologies.

## **Encourages "Best-of-Breed" Technologies**

The common argument among those who would restrict technology transfers is that it only benefits the technologically inferior party. They believe that the international partners and their industry benefit far more from the technology than does the United States. Interestingly, this view is not widely held by many in government leadership, industry, or high-tech laboratories and smacks of technical hubris. Admiral Enewold believes that the U.S. has benefited tremendously from foreign participation in the program.

From a program manager perspective, there are all kinds of technical benefits. We find stuff that other people are doing that we haven't thought of, you get all ideas not just U.S. ideas. The perception in the system is that all the technology is leaving shore, but the truth of the matter is that there is stuff coming on shore also; especially in

manufacturing. We see Euro fighter as being the state of the art manufacturing that set up those kinds of things.<sup>81</sup>

Mr. Warren Boley, Vice President of F100 engines at Pratt and Whitney, is a firm believer in taking advantage of the global industrial market. He remarked on the collaboration between the U.S. and the Japanese:

Pratt benefited directly from Japanese production methods namely from Toyota moving production line processes. Japanese quality on the F100 was very good and did not have many of the problems that Pratt encountered. This was due to process control and lean manufacturing methods, much of which we incorporated in our processes. While Pratt was aware of the theory, the Japanese went beyond theory to demonstration.<sup>82</sup>

Many U.S. industry professionals say most foreign technology transfers on-shore are in the form of production capabilities and represent better value for the dollar. “In 1980, 100% of Pratt engine parts were manufactured in Connecticut. In 2000, only 30% of parts were. Now, 70% are manufactured by other suppliers, many of them being international.”<sup>83</sup> While Pratt can match the quality of these parts, they found they could not beat the value due to much lower burden rates (Mr. Boley cited \$65/hr labor rates compared to \$16/hr overseas). But what about the concern of giving away too much for short-term wins? Mr. Boley indicated there is still plenty of room between export restrictions and where U.S. industry would like to be before they would even get close to giving away the crown jewels. Industry, in general, does not believe that many of the technologies that are labeled ‘critical’ should be in a category that requires protection. Moreover, clearly they do not fear invigoration of global competitors as a result of the licensing agreements, otherwise they would not pursue outsourcing these technologies.

It is interesting to note that while many in government, the military, and industry are sanguine regarding international cooperation and their accompanying technology transfers, other stakeholders have erected safeguards against what they consider a threat to the U.S. interests. Such safeguards come in the form of regulations on non-disclosure policies and outright prohibitions in public law, such as the Buy America Act discussed in the next chapter. Many, if not most, of these safeguards were intended to protect the industrial lead the U.S. enjoyed and prevent other nations from achieving parity with the U.S. military on the battlefield. Unfortunately, most of these safeguards have outlived their

useful life, preventing the U.S. from taking advantages of the global industrial defense market and from achieving its stated national security strategy goals. The next chapter will analyze the disadvantages of international cooperative programs and address some of the roadblocks that limit their success.

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## **Chapter 4**

# **Liabilities of and Barriers to International Armament Cooperative Programs**

In meeting our national and global security obligations, collaborative programs with allies offer the potential for common doctrine, shared training, and far greater operational integration in combat. That level of collaboration also demands greater access to sensitive defense technologies than we are accustomed. It also may demand technology transfers at a pace and volume our current laws, regulations, and management systems cannot handle safely.

Government Accountability Office Report on JSF  
Acquisition, July 2003

## **Political Analysis**

The United States has committed to the design, development, and testing of the JSF with foreign partners. In doing so it also, for all intents and purposes, has approved the development of a configuration common within the limits of national disclosure policy. Congress, Commerce, State, and DoD, all approved the acquisition strategy.<sup>84</sup> The devil is in the details—now the hard part begins. Each U.S. stakeholder has its own peculiar interests and concerns. Congress and Commerce are interested in keeping jobs at home and preventing the U.S. from ‘giving away the farm’ in critical military technology transfers, thereby invigorating industrial competitors. State is concerned with ensuring industry is following the export control process and not upsetting the balance of regional powers. DoD is concerned with technology exploitation and third-party transfers to rogue states. In a sense, it was easy to say that the U.S. would design, develop, and sell up to 2000 fifth-generation stealth fighters to its allies. However, the commensurate laws, disclosure policy, and acquisition environment is diametrically opposed to doing much of this. Said another way, laws, regulations, and policies are hard-wired against such a strategy. The following sections will describe the disadvantages of international



cooperative programs, due to their nature and the hostile environment in which they often must operate.

### **Risk of Partner Defection**

Work share, in international parlance, can be a four-letter word. Much of the acrimony in international partnerships surrounds how to divide the available work among the partner industries. The European Fighter Program is the ‘international poster-boy’ for unsuccessfully tying work share to the total aircraft buy of each partner. This approach unraveled when French officials demanded 46% of the division of labor even though they were only going to purchase 25% of the production run.<sup>85</sup> France eventually withdrew from the EFA program, leaving the remaining partners to divvy up the work. Each time a partner’s parliament decided to reduce their buy due to fiscal constraints, work share had to be renegotiated. This was inefficient and expensive due to delays and costs of contract modifications and terminations, and was further exacerbated by the difficulty of finding meaningful work among partners with unequal manufacturing capabilities. It also instituted an unstable system; each cut produced higher unit costs thus putting pressure on the partner countries to reduce the buy, thereby adding pressure to raise costs. The European Fighter Aircraft unit cost eventually reached \$110M USD, making it almost as expensive as the F-22A with arguably much less capability.

Not all was well in paradise either. When JSF adopted the revolutionary work share approach “best athlete,” it worked well initially. After a time, however, it became clear some of the partner industries were not winning what they believed to be their fair share of the ‘pie.’ This was despite the program office and Lockheed-Martin making it clear, during the MOU discussions, that money ‘won’t buy you love.’ The Program Office tinkered with another approach termed “strategic sourcing,” which modified the best value approach by allowing work packages to be directly awarded to foreign partner industries where contract awards had not met partner expectations. Only a few contracts were ever awarded on this basis because it created more hate and discontent than it was worth.<sup>86</sup> The countries that were most competitive viewed it as breaking a promise of best value. U.S. stakeholders began asking why they were spending more money on poorer performance. The Joint Program Office moved away from strategic sourcing, although not exclusively. It is now used only in those rare cases where there would be no contract awarded to a partner country.<sup>87</sup>

A second reason for defection is increased cost. Escalating unit costs, due to a U.S. reduction in the buy, development delays, or

production delays have been a prime cause for partners to leave in droves. This scenario was foreseen by European defense experts: “If the F-35 does not meet its cost numbers and adhere to schedule, the foreign partners will bail out of the effort and the export market for the aircraft would disappear overnight, causing what is called the “death spiral” of the program.”<sup>88</sup>

A third reason for defection involves inordinate partner expectations—they almost always exceed the art of the possible. Turkey and the Peace Onyx co-production of the F-16 is a prime example. Turkey saw the agreement as an opportunity to improve their long-term military modernization goals while bolstering their defense industry.<sup>89</sup> Throughout negotiations and into the production, however, they employed hard-line tactics seeking to shield themselves from financial risk by tying the U.S. to financial oversight. The U.S. eventually hedged against this approach by definitively stating in the contract, “it is understood that the U.S. government will not be responsible for assuring the initial or future viability of the Turkish industrial base or Turkey F-16 related facilities.”<sup>90</sup> Ultimately, while the modernization of Turkey’s Air Force was achieved, Turkey’s relationship with the U.S. was damaged.

For the JSF, the original country MOUs and subsequent exchange of letters<sup>91</sup> outlined what each partner hoped to secure in long-term benefits. Unfortunately, lack of progress on the exchange of letters has been a great source of frustration for the JSF partners, causing several of them to threaten to pull out of the program.<sup>92</sup> Most of these requests ran afoul of the national disclosure policies and were further exacerbated by the bureaucratic process of national disclosure policy exceptions. The partners were upset that the JSF program office lacked the authority to act as a final policy adjudicator. Many of the partner’s requests dealt with long-lead issues, such as depot maintenance, that require more time to define programmatically. These negotiations took an immense amount of the program’s time working out details and reassuring partners that the disclosure process was being engaged. At the end of the day, all international programs are at the mercy of the national disclosure community. This process is not clear-cut and must be negotiated carefully with political adeptness and patience outside of the view of the international community thereby increasing suspicions.

Not all can be blamed on the disclosure process. A program can also be its own enemy by making promises to partners that have not been vetted at the appropriate levels. Ultimately, clear communication and managing expectations early is critical to avoiding much of the rancor. Such has become a full-time job for JSF program office officials. Admiral Enewold explained:

We need to get the expectations down on peoples financial contributions and expected outcomes of the program. I think that we... I won't say rushed into the MOU's, I think we talked passed each other during the MOU discussions. Each of the countries have a business case as to why they want to be part of JSF both operational, financial, industrial participation, coalition, it ran the gamut. But I don't think they understood how we were going to include them into the program and certainly we didn't understand how they wanted to be included into the system. We're working our way through a lot of this stuff right now and it has been pretty painful at the beginning. For the first three or four years it was pretty rocky with them saying, well, I thought we were going to do this and we said no, we're going to do this ... so trying to get the expectations down at the start is really important. Overall, it has been a healthy dialog. It's not been as bad as the press and everybody says it is; it's actually working pretty well. You have to remember, none of these countries are taking possession of their airplanes for at least five years, maybe ten, so we have some time to work these issues. Just by virtue of the lead time, it's impossible to determine how this is all going to work but every body wants to know now.<sup>93</sup>

In a recent 2003 report on the JSF, the Government Accounting Office (GAO) addressed the same issue as a primary concern. "Differing expectations between the U.S. and its partners are inevitable. Partners have complained that their expectations regarding technology transfer, indigenouness sustainment, and industry work share have not been met."<sup>94</sup> Risks of partner defection abound due to any number of factors. Nothing, however, is more lethal to a program than the country-lead canceling because they have assumed too much risk.

### **Undue Risks Assumed by Lead-Country**

A hearing before the House of Representatives Subcommittee on National Security Emerging Threats and International Relations discussed the concern over the U.S. taking the bulk of the development risk for JSF. The committee asked whether international participation and technology sharing are being managed so as to maximize benefits and minimize risk to the Department of Defense.<sup>95</sup> A GAO report, released earlier, found the JSF program in need of stronger management and oversight, because

international participants, “currently have no requirement or incentive to share in cost growth.”<sup>96</sup> The report was right. The JSF MOU cost sharing provisions require the program director only to notify the partners if there is a cost increase or overrun.<sup>97</sup> There is no requirement for the partners to ‘pitch-in’ covering their commensurate share beyond the previously agreed upon target cost. What would be the incentive for the partners to pony-up when the tin cup was passed? The JPO says because it would be in the partners’ best interest since the health and future success of the program is critical to achieve the force structure updates the JSF partners require.<sup>98</sup> It remains to be seen if this is what truly would happen since the JPO has not gone back to the partners and asked, even after a \$3B cost increase ensued following a weight reduction exercise in 2004. Moreover, passing the tin cup does not engender an atmosphere of trust amongst the partners. While Congress clearly called this one correctly, sometimes it doesn’t need all the facts before it injects itself into the process.

### **Invigorates Industrial Competitors**

On the surface, Congressional fears of losing U.S. jobs to offshore defense contractors appear to be warranted. In the F-15, F-16, and F-18 programs, several countries<sup>99</sup> legally secured co-production licenses. Turkey produced 46 F-16 aircraft for Egypt under the Peace Vector agreement. Israel developed two aircraft in the KFIR and Phantom 2000 programs that were considered to be in competition to U.S. foreign military sales and sold them on the international market.<sup>100</sup> The U.S. lost business to aggressive Israeli modernization kits for Turkish F-4 Phantoms and a \$20M Radar Warning Receiver upgrade to Venezuelan F-16B aircraft.<sup>101</sup> While these sales were significant for the countries producing them, however, they were insignificant in terms of total jobs lost to U.S. industry.

To be fair, sometimes a country illegally transfers technology that can harm U.S. industry. Israel is the worst offender of third-party transfers,<sup>102</sup> which involve taking U.S. technologies and porting them over to another weapon system. Israel sold missile and tank technology to China in the 1990s and more recently has sold, to non-aligned countries such as India, advanced avionics in the Python missile, a derivative of the U.S. Aim-9 Sidewinder, and the Mapatz anti-tank missile developed from TOW-2 technology.<sup>103</sup>

This type of behavior, fortunately, is not the norm. Japan co-produced nine tactical fighters and trainers with the U.S. over 26 years but has not used the technology for other markets. Indeed, co-production technology does not give a country much of the know-how to develop

indigenously capability. It should be noted that it took Japan 22 years, from its first co-production program, to where they were capable of developing their own indigenous fighter in the F-1.<sup>104</sup> Years later, Japan abandoned its plans to develop the FSX (F-2) on their own, opting instead to co-develop it with Lockheed-Martin.<sup>105</sup> Ironically, at the time of the FSX decision in 1989, Japan had been co-producing F-15s with the U.S. for 12 years but still did not have the ability to produce a fighter indigenously.<sup>106</sup> Speaking from his cooperative relationship with Japan on F100 co-production, Mr. Warren Boley, Vice President of Pratt and Whitney for the F100 engine, did not see the danger of technology transfer invigorating an engine competitor. “[T]he Japanese have been very respectful of intellectual property, the TAA, and the ITAR restrictions on their licensed production. They have been producing the F-100 since the 1980s. Pratt has not seen an industrial competitor out of the Japanese on tactical engines.”<sup>107</sup> Today, over 15 years later, Japan is still not competing with the U.S. in defense exports or commercial offshoots such as jet engines. Unfortunately, bad experiences can give the impression that technology transfer automatically equals plundering our defense intellectual capital; such is generally not the case.

Rather than take a protectionist stance, Dr. Tom Cruse, the technical director of the Air Force Research Laboratory (AFRL), believes the U.S. benefits from technology collaboration. The lab actively seeks technical exchanges with foreign research partners, particularly in theoretical areas, because many countries are ahead of the U.S. in certain fields. These exchanges often provide a catalyst for innovation.<sup>108</sup> Many in industry agree. When it comes to applied research, transfers bring enabling technologies that solve difficult problems. The Short Take-Off and Landing (STOVL) technologies that power the JSF Marine Corps variant would not be possible if were it not for offshore partners.<sup>109</sup>

Even in the unlikely event technology transfers were to create an offshore competitor, Colonel Michael Leahy of AFRL’s Air Vehicles directorate believes, regardless of its origin (domestic or otherwise), that competition is a good thing:

Competition is key; you stay ahead with it not by protecting your technologies. The more the U.S. invests in technology to stay ahead, the more it outweighs protecting the family jewels. Once a technology gets to the market, it’s a commodity and you don’t get ahead by protecting a commodity, you get ahead and stay ahead by doing the next thing...technology protection is very difficult to do in terms of time and cost.<sup>110</sup>

Doctors Cruse and Leahy believe that U.S. industry lacks a natural predator and would benefit even if it came from a foreign competitor. “If one prime contractor wins, he just brings the other one or two on board.”<sup>111</sup> Such an ‘everyone gets a trophy’ atmosphere does not engender taking risks on new advance opportunities. Leahy noted, “Boeing is taking risks today on the 787 they would never have taken if it wasn’t for Airbus scaring the [expletive] out of them. This has engendered a ‘bet the company’ environment and benefits commercial industry by encouraging innovation. Competition, even if invigorated by technology transfer, is a good thing.”<sup>112</sup> Slightly modifying a famous quote by Alan Kay, the father of the graphical user interface (which everyone copied), “[t]he best way to *protect* the future is to invent it.”<sup>113</sup> Like the political realm, however, there are downsides of international programs to the warfighter. The next section will address some of the more salient ones.

## Strategic Analysis

### Limits of Coalition Warfare

The U.S. National Security Strategy acknowledges the limits of coalition warfare: “[s]ome allies and partners will decide not to act with us or will lack the capacity to act with us.”<sup>114</sup> The Combatant Commanders, during the Blue Team process discussed earlier, expressed concern that coalition partners often lacked the capabilities and training to accomplish critical warfighting tasks or the political will to do so. Successful coalitions cannot be achieved through ad hoc coalitions of the willing argues Jeffery Balios of *Defense News*. “Coalition war fighting is not like a pick up game of basketball, rather, it requires joint training, new doctrine and creating institutional ‘plug and play’ command and control architectures.”<sup>115</sup>

Following the first Gulf War, General Horner lamented:

Though F-16’s are easy jets to fly and maintain, it is difficult to maximize the full capabilities of this amazing aircraft’s avionics suite. In the USAF, years of training are required before pilots are capable of using the F-16 to its fullest. The Bahrainis didn’t have a year, and they didn’t have homegrown leaders who had fought in Vietnam to guide them.<sup>116</sup>

The Combatant Commanders are interested in releasing advanced capabilities only to those countries that will train with the U.S. and have the political will to employ these capabilities along side of the United States. NATO countries and Australia have shown the greatest willingness in this regard. Ostensibly, this was an important factor in determining who the JSF sought as partners. Countries outside this fraternity pose greater risks. There is always the question, how they will handle the technology, or worse, who will they give it to?

### **Rogue Nation Scenario**

Rogue nation concerns are often invoked but rarely live up to their billing. When a nation goes rogue, the consequences have been dubious. Perhaps the classic example of the 'rogue nation' scenario is Iran following the 1979 Islamic revolution. The U.S. had delivered 79 advanced F-14 Tomcats<sup>117</sup> to the pro-Western Shah regime, only to find them in the hands of revolutionaries now bent on the West's destruction. How the Iranians would use the F-14s, or perhaps who they might share this technology with, was of great concern to the U.S. The U.S. responded by cutting off all spare parts, which significantly limited Iran's ability to sortie the aircraft. The aircraft was never employed against the U.S., and the technology has since been superseded. Unfortunately, in July 1988 the *USS Vincennes*, patrolling in the Persian Gulf, misidentified an Iranian Airbus A300 jetliner as an F-14, shooting it down and killing all 290 passengers.<sup>118</sup> More recently, Venezuelan President Hugo Chavez glibly threatened to sell some or all of his 20 F-16A/B fighters to Cuba or China because the U.S. withheld spare parts. Chavez intoned: "[m]aybe we will just send them back to them, or perhaps we will send 10 planes to Cuba, or to China, so they can have a look at the technology of these aircraft."<sup>119</sup> Clearly, ten or twenty F-16s are not going to make even a tactical difference in any conflict between Venezuela and the U.S., nor will it change the balance of power in the region.<sup>120</sup> Turning over aircraft to hostile nations who have the intent to exploit technologies and determine vulnerabilities, however, could be harmful in some scenarios, but not in this case, as the technology is 25 years old. With high-tech weapon systems, however, the U.S. is concerned about three areas: technology migration/transfer, information exploitation, and the U.S. ability to counter if such capabilities are employed against them.

### **Information Exploitation**

Exploitation can be defined as reverse engineering to determine how a system works for the purpose of manufacturing a like system or

determining vulnerabilities. Exploitation is most often used to determine the capabilities and vulnerabilities of a system so that an effective countermeasure can be developed, thus negating capabilities. Effective exploitation, however, normally requires several components: capability, intent, opportunity, and time. Oftentimes countries come into possession of advanced defense technologies but do not possess one or any of these components, thus deriving no benefit either industrially or militarily. On these occasions, however, a third party transfer of the technology can occur. Most of these transfers are for financial gain and can be extremely damaging when made to nations with the capability and intent to exploit. Fortunately, however, payoffs do not occur overnight. Even when a country possessing the capabilities comes in possession of a high tech weapon system, it takes years and sometimes decades to fully exploit the capability—possession does not equal immediate gratification. This notion was a common argument against including high-tech capabilities with the JSF. The Joint Program Office countered that aircraft were being sold to trusted NATO allies who were not likely to ‘go rogue.’ Additionally, they were to be sold to their respective defense forces, not their industrial centers. Moreover, critical or highly sensitive technologies, such as sensors and low observable technology integration, would be carefully controlled, produced, and maintained by U.S. depots. Finally, these nations would not receive the capabilities or technologies for up to fifteen years. With conservative estimates, even in the unlikely event that a country made a concerted effort to exploit the technologies and was able to overcome anti-tamper techniques, it would be years before any real benefits would be derived.

## **Business Case Analysis**

### **Incorporating Partners in Daily Operations**

At the Defense Systems Management College in Ft. Belvoir, VA, future senior acquisition professionals are schooled in the rigors of program management and how to navigate the often troubled and complex waters of acquisition. Numerous perils lay in the path to successfully executing a program: requirements development, budget instability, source selections, and managing in a volatile, uncertain, complex, and ambiguous environment. Added to this are seemingly yearly acquisition reforms that are designed to ‘unleash’ the program manager but often serve only to fetter him in a morass of acquisition regulations, milestone documents, and federal law. Major Gen Hough (USMC), former JSF program



director, lamented that, prior to acquisition reform, a major milestone review required him to deliver 18 major documents to the Defense Acquisition Executive but now, as a result of acquisition reform, he only has to deliver 24! Werner von Braun once remarked, “We can overcome gravity, but sometimes the paperwork is overwhelming.”<sup>121</sup>

If this environment were not difficult enough, program managers must now determine if pursuing an acquisition strategy that includes international cooperation is a prudent course. Along with the benefits come additional regulations, laws, and interagency coordination that increase their overhead in an already constrained (fiscal and manpower) resource environment.

The first such challenge is what to do with foreign program office personnel. There are currently 50 internationals in the JSF program office. This number will swell by an additional 40 people once operational tests begin. Each foreign national is assigned duties alongside their U.S. counterparts. Seamless integration of the internationals, however, is another matter. Due to national disclosure policy, foreign personnel are not allowed access to any information or material that has not been reviewed by the disclosure office and to which they have been cleared. This includes any ‘For Official Use Only’ material through collateral Top Secret. The practical implications can and have been very difficult on program office staff as well as being the source of great frustration to international partners. International personnel often view such policies as ‘slow-rolling’ or deliberate stonewalling. On some occasions, information is never released, which damages positive relations with the partners who have, in their minds, paid good money to have access to information they deem necessary to making informed decisions. A second challenge with partnerships is dissimilar interests. Partners often come with unique requirements they desire to fulfill through a weapon systems acquisition and a program manager must seek to satisfy.

### **Diverse Partner Requirements**

Requirements have long been the bane of acquisition programs. Requirements creep, changing requirements due to changes in threats and gold plating, can kill any development program.<sup>122</sup> The longer the development cycle, the greater the probability requirements will change, resulting in higher costs. The average acquisition program is susceptible to creep because cycle times have increased to 175 months.<sup>123</sup> If the acquisition program is joint, formulating a common set of requirements between the services becomes more problematic. The services clearly intend to use the weapon system for different missions. For example, one

service requirement, such as carrier suitability, may be so far outside the trade space for another service that it precludes a critical capability of the former. Ultimately, all services must compromise their requirements. One of the remarkable achievements of JSF is the services were able to hammer-out a Joint Operational Requirements Document and yet still maintain a high level of commonality among the three variants. Requirements have also been the most troublesome factors affecting collaborative attempts between states.<sup>124</sup> The JSF had to trade requirements across three services and eight countries. This could have become untenable. The JSF, however, included many of the partner countries in the process early and was able to define a common set of mission capabilities. This highlights the need for all parties to achieve agreement on the overall specifications and reach consensus on performance, capabilities, and operational characteristics early.<sup>125</sup>

Oftentimes programs have to invent new processes on schedule because much of the international cooperative depths remain unfathomed; processes and even laws need to be created to accommodate the complexities. Colonel Mike Williams, former F-16 Systems Program Director, related the following challenge during the early days of the F-16 program. At that time the MOA with the original European Participating Air Force countries (Norway, Denmark, Belgium, Netherlands, and Portugal) was the largest section 27 cooperative development program:

They asked us to co-produce. We had never co-produced before. This was the first time we just didn't sell them our developed aircraft. The system didn't know how to handle a co-production program. An MOA was produced. It bound the five partners together. They had to create their own law and even a bank. We had to modify ancient foreign military sales rules from the post WW II era intended to sell jeeps and spoons to something useful for the complex European program.<sup>126</sup>

As seen above, international programs are not conducted in a vacuum. Their very nature demands coordination with agencies outside the DoD. Weapons acquisitions are challenging enough, but they can become extremely complex when the interagency process is introduced.

### **Interagency Involvement in the Acquisition Process**

There is no central decision-making authority within the export control process.<sup>127</sup> Authority is spread throughout the executive agencies and Congress. At inception, international agreements for armaments

cooperation programs must complete the interagency consultation and congressional notification requirement.<sup>128</sup> In addition, the Case Act requires executive agencies to consult with the Secretary of State before signing an international agreement. Finally, DoD is required to consider the effects of any international agreement on the U.S. industrial base and, in consultation with the Department of Commerce, determine the potential effects on the international competitive position of U.S. industry. In all, the export control process can involve as many as seven cabinet-level departments: President, Department of State, DoD, Department of Energy, Joint Staff, National Security Council, and National Economic Council.

Once the program is approved, several interagency working groups may become involved in the process of developing the acquisition strategy and reporting at required milestones, these include: the Advisory Committee of Export Policy; the Economic Defense Advisory Committee; the Committee on Foreign Investment in the U.S.; three interagency escalation groups (e.g., resolution of interagency disputes); three different intelligence agencies; two independent agencies; and three enforcement agencies.

National Disclosure Policy-1 describes the authorizations process for DoD export policy. The Secretary of Defense and the Undersecretary are the principal adjudicators of export decisions. They delegate secret level decisions to the service international program offices at the service staff levels. It is rare, however, for a single service international program office to have approval authority for an export decision. The service levels are just the first stop in a long coordination line. Most export decisions regarding disclosure, technology, end items, or capability must be vetted by the National Disclosure Policy Committee, a joint interagency committee chaired by the Defense Technical Security Administration. It develops and implements technology and security policies for international transfers and prepares for the future threats through activities and programs that control, monitor, and prevent the transfer of defense related goods, services, and technologies that can threaten the U.S. national security interests.<sup>129</sup>

Other agencies represented within the community are the Undersecretary of Defense for Policy, Service International Program Offices, Undersecretary of Defense for Acquisition, Defense Threat Reduction Agency, NSA, CIA, and NRO. Unfortunately, the National Disclosure Policy Committee only adjudicates unclassified and secret level decisions. Technologies or capabilities at the Special Access Required levels are delegated by the Secretary of Defense to the Low Observables/Counter Low Observables Export Committee. This

committee is chaired by the Undersecretary of Defense for Acquisition and administered through the Special Programs office. A tri-service group chaired by representatives from the Special Programs groups of each service act as a lower committee to vet issues prior to meeting the export committee.

Finally, if a system has any cryptological capabilities (JSF has 16 keys), algorithms, or technologies, it must receive approval through the National Security Agency (NSA) on a case by case basis, unless a Combatant Commander specifically requests an exception. Interestingly, the NSA reports to the Director of Policy, who also owns the Defense Technical Security Administration. On the one hand, such consensus staffing is important; but on the other, it can be terribly inefficient.

One wonders why these processes cannot be integrated under one adjudicating body. Complicating this frustrating process are other DoD agencies that occasionally have ‘rolled-in’ during the vetting process and carried a significant veto-like voice. When this occurs, the program office must spend more time to explain and convince ‘all-comers’ why such a decision is being sought to assuage their concerns. According to the Defense Technical Security Administration website, they perform the export control function “consistent with foreign policy and national security objectives.” Unfortunately, they own but a small piece of the puzzle. A truly interagency committee, whose chair is empowered by the Executive branch and DoD to make decisions within a year’s period, would significantly improve the export control process. Such decisions cannot be made on the consensus of a disparate set of communities in sequential fashion—this is too inefficient and sustains stovepiping. Such a process can best be accomplished with a single committee. A central, ‘one-stop-shop’ is required to fix this broken process.

The JSF program office has sought to stay ahead of this process by conducting senior-level reviews every four months. These reviews are at the 3-star or equivalent level and include the Service Acquisition Executives, the requirements communities, and all the partners and their principal users together. This meeting can have up to 60-75 general officers to make sure everyone is baselined on the program. In addition, every six months the joint program office brings together the Chief Executive Officers from Lockheed-Martin, Northrop-Grumman, BAE, Pratt and Whitney, GE, and Rolls as well as the Service secretaries, Undersecretary of Defense for Acquisition, Service Acquisition Executives, requirements users from the services, and the national armaments directors from each of the partners and their chiefs. All told, up to one hundred 4-star level executives convene every six months.

While Admiral Enewold believes this process is valuable from the standpoint of keeping down the ‘urban rumors,’ he also admits it can be very cumbersome.<sup>130</sup> An even greater challenge, and often a barrier, is the U.S. export policies, processes, regulations and laws, which are not friendly to international entrepreneurial environments.

### **Complexity of Policies, Processes, Regulations, and Laws**

DoD warns program managers that international cooperative programs are fraught with red tape. “The complexity of laws, regulations, and policies that apply to armaments cooperation activities should not be underestimated.”<sup>131</sup>

The most important point to remember about the legal basis for armaments cooperation activities is that international program related statutes and associated regulations and policies in most instances apply in **addition to, not instead of**, applicable domestic DoD acquisition laws and policies. Acquisition personnel, with the assistance of supporting DoD international programs organizations, must comply with both domestic and international cooperation related laws, regulations, and policies while developing and implementing armaments cooperation initiatives.<sup>132</sup>

Delays and uncertainty in acquisition are not conducive to efficient or profitable operations.

Lockheed-Martin and the program office have the unenviable task of pushing through timely and favorable disclosure decisions and in some cases, exceptions to national disclosure policy. Under law, U.S. contractors must receive authorization to transfer needed data and technology through the export licensing process. Export authorizations for critical suppliers need to have timely planning, preparation, and deposition to avoid costly schedule delays. The joint program office attempted to streamline this process through what was called the Global Project Authority. Over a year was spent pushing this initiative through the disclosure process, specifically, the State Department. The purpose was to identify common, non-sensitive, unclassified, technical data associated with JSF subcontracting activities. For example, Technology Assistance Agreements (TAAs) are required before any technical discussions can take place between the U.S. contractor and a foreign contractor. Such discussions are necessary before the U.S. contractor can determine if the foreign entity even has the capabilities to design and manufacture a particular part. Before the Global Project Authority,

thousands of individual TAAs had to be submitted serially though this process. The majority were standard requests with no critical information exchange required. This process invited the ire of the partners. The Global Project Authority was eventually approved, but the authority given to the joint program office was so watered down that it didn't help over the original TAA process. Even Canada's statutory advantage of exemption from U.S. International Traffic in Arms regulations did not eliminate their need for TAAs. The partner's single uppermost complaint of the JSF program is the ineffectiveness of the Global Project Authority.<sup>133</sup>

Another example of a law restricting the flexibility of international programs is the Buy American Act. Codified in 1933. Many consider this to be a leftover from a prior protectionist's era. The act, on the surface, appears to make the playing field very uneven, requiring acquisition of U.S. only products for public use. Fortunately, there are five waivable conditions that are often invoked with success by U.S. industry and government acquisition professionals. While these waivers take some of the teeth out of the Act, it is still a concern to industry and program managers because of its complicated nature, the requirement for certification of compliance, and its continued existence even in the post-acquisition reform era.<sup>134</sup> It appears disingenuous to foreign partners, who already suspect U.S. export and import policies to be rigged against them. Adding to this perception are frequent forays by unions and Congressional stakeholders who invoke the act when they perceive threats to local jobs. Protests typically range from loss of U.S. industry share to out and out protectionism. U.S. Senator Russ Feingold, concerned over the abuse of the act's five waivers, recently proposed broad changes to the act to prevent, as he put it, the "hemorrhaging of U.S. manufacturing industry."<sup>135</sup> Part of the complexity stems from its implementation in the Defense Federal Acquisition Regulations. The Federal Acquisition Regulation (FAR) defines the "unreasonable price" difference (waiver number 2) as six percent. The regulations increase this to 50 percent, for which there is no basis in statute or regulation.<sup>136</sup> Ultimately, such regulations limit a manager's ability to choose amongst a globally competitive market. The Federal Acquisition Streamlining Act panel of 1994 recommended Congress repeal the restrictions and reporting requirements but these were eventually rejected. The rationale for removing the restrictions was cogent:

Commercial sellers should be able to utilize their established facilities, technology, supplier networks, processes, employees and other standard commercial

practices in performing Government contracts. The reality that global markets exist and that global markets can be responsive to mobilization needs must be recognized. Waiver is not always possible under current regulations. It is to our strategic and economic advantage to maintain vital foreign sources during peacetime as well as domestic sources or at least have the option to do so when market conditions and the international situation so dictates.<sup>137</sup>

Such laws add more requirements to an already too-full agenda, requiring program managers to determine if a proposed acquisition is in compliance with the Buy American Act and certify such in the contract. Violations come with commensurate penalties, including grounds for protest of a contract award to a foreign source by domestic suppliers that are unsuccessful, industry debarment from bidding on contracts for contractors who violate the provisions, and stop work orders on contested contracts while the protests are adjudicated.<sup>138</sup> The unintended consequences include limiting technology options, decreasing competition and innovation, and lengthening the development cycle, thereby increasing costs.

### **The Impact on the Development Process**

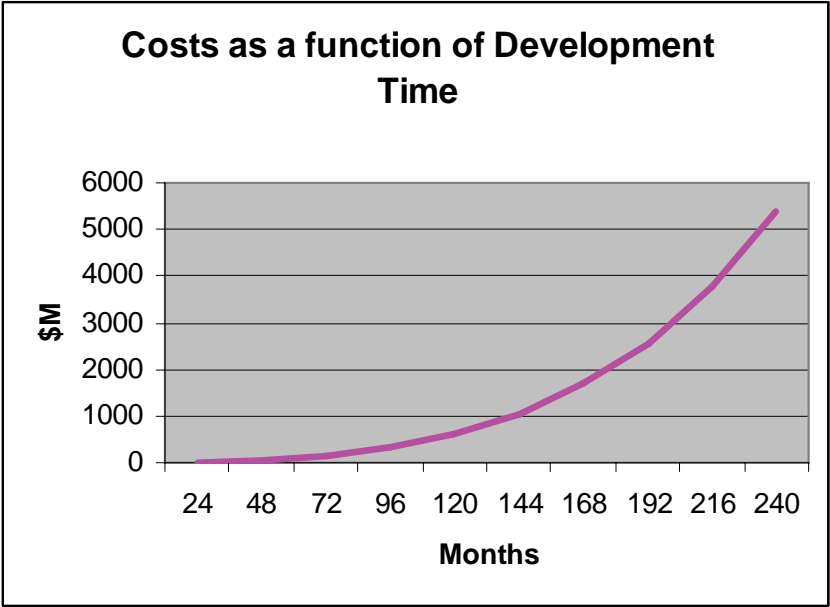
Of all the “best practices” adopted by JSF, perhaps the most revolutionary was termed “Cost As an Independent Variable” or CAIV. This simply meant that a cost cap was set for each aircraft variant such as \$40M per unit for the Air Force. This cap served as independent variable when determining what requirements the Air Force could afford. If a requirement caused the unit cost to be exceeded, then that requirement was said to be outside the trade space or other requirements were traded off to make room under the cap.

When the JSF program office was directed to develop a partnership version of the aircraft that satisfied the national disclosure policy criteria other export restrictions, the team determined that the non-recurring engineering required to develop a delta configuration based upon current disclosure limits was prohibitive.<sup>139</sup> But the trade space for the partnership version was mostly out of the hands of the program office and at the disparate whims of State, OSD, and Congress. Program office engineers wryly referred to this approach as ‘DAIV’ (Disclosure As an Independent Variable). Unfortunately, this ‘export compatible’ version’s cost was to soar due to the differences mandated by export controls and disclosure rules. Much of the funding contributed by the partners was going to be used not to pay for development costs of the baseline aircraft

but for non-recurring engineering of the partnership version. After over a year, and much coordination with the far-flung disclosure community, the JSF team was able to significantly reduce restrictions, and consequently the ‘delta’ costs. Much of the burden, however, was shifted to the anti-tamper design to ensure the technologies would not be exploited.<sup>140</sup> This cost is classified but it is a significant additional burden that was not included in the original contract award. Ironically, none of the countries would receive this ‘critical’ technology for thirteen years or more. Ostensibly, technology at this point would no longer be considered ‘critical’ but rather ‘commodity.’<sup>141</sup>

Long delays in the development phase of any program can be a costly penalty to pay. A study on the cost of acquisition delays concluded the development costs of an average program is related to the following equation<sup>142</sup>:

$$\text{Dev Costs (\$M)} = (1.36 + 0.3 \times \text{development time in months})^4$$



**Figure 8. Increased Development Cost as a Function of Delays**

For example, according to the model, if JSF had a development time of 144 months and was delayed an additional 10 months, the corresponding cost increase would be \$238M dollars.<sup>143</sup> This is not to say all delays are due to the export control process. Under the present system, however,



delays are inevitable because of disjointed release processes spread across the DoD and other executive agencies.

Each of the aforementioned challenges, in and of themselves, can be daunting; collectively, they can quickly becoming paralyzing to any program. Defense program management in the 21<sup>st</sup> century is not for the timid, and adding an international cooperative flavor, while oftentimes beneficial, must be done with malice of forethought. The following conclusions and recommendations are put forth to improve the success of such endeavors. The recommendations will require a powerful champion within the defense acquisition system because they are comprehensive enough to knock over more than a few rice bowls and challenge some well defended fiefdoms. Without their implementation, however, the U.S. will continue to castrate the geldings and bid them to be fruitful and multiply.

## **Chapter 5**

### **Conclusions and Recommendations**

There is a broad perception in the defense community, here and in Europe, that the DoD does not view globalization as a policy tool to facilitate interoperability and competition. This perception is fueled by the reality that, despite years of effort, the regulatory hard wiring for globalization is still not in place. Underlying these are serious questions over the U.S. commitment to true coalition war fighting and alliance relations. In short, despite rumors of megadeals, we are not ready — institutionally, culturally or politically — to create a truly trans-Atlantic set of primes that draw transformational research and development from the United States and its allies and share technology across national boundaries.

Jeffery Balios, *Defense News*

### **Conclusions—Conditions for Successful International Cooperative Programs**

International armament cooperative programs can be a beneficial acquisition strategy for future weapons procurement in the United States. An analysis of past and current programs reveals significant advantages across all three dimensions of political, strategic, and business realms. Among these are strengthened alliances, reduced acquisition costs through economies of scale, bolstered defense industrial base, provision of capabilities and interoperability to our allies, and finally, increased program flexibility through cost and risk sharing, thereby availing the manager with the best of technologies. The truthful answer to any acquisition question is, “it depends.” As such, there are no secret formulas guaranteeing a successful program. From the JSF experience thus far, however, and previous international programs, nine salient conditions appeared most often and portended success. Not all of these

conditions need to exist simultaneously, or even at all; but to the extent they do exist, they appear to increase the probability of a successful cooperative venture.

The following conditions that portend success are in no particular order:

1. Solid political and economic ties with the U.S.;
2. Record of fair and equitable dealings with the U.S.;
3. Similar military requirements; and mutual agreement on party expectations;
4. Reasonably robust defense science technology base;
5. Defense treaty aligned partners with the U.S. such as NATO or ANZUS;
6. Trusted ally with no record of third-party transfers;
7. A national security policy that can accommodate international cooperation;
8. Existence of complementary interests such as political or domestic interests; and
9. Sound weapons program, technically, programmatically, and fiscally

## **Recommendations to Policy Makers and Program Managers**

With any partnership, along with the benefits come liabilities. These include inefficiencies from more stakeholders to satisfy, risk of partners defecting, undue risks assumed by the lead country, incorporating foreign nationals in the program office, a complex interagency national disclosure process, and additional laws, regulations, and policies. While these problems hamper a program, most barriers are self-inflicted. The U.S. defense acquisition system, and the statutes under which it must operate, does not take advantage of the global market environment. Many of our policies and statutes discourage international competition. Concerns over critical technology transfer and export controls directly affect the health of the U.S. defense industry in a global market environment. A recent panel of acquisition experts concluded: “DoD has not adequately addressed the globalization of the defense industry.”<sup>144</sup> The following recommendations address the inherent limitations of international programs, and the policies, regulations, and laws in the U.S. that limit their effectiveness.

## Policy Makers

1. Approach ‘critical technology’ export decisions at the capabilities level. Include the timeframe when these capability-enabling technologies will be delivered and to whom they will be delivered. If timelines are short, protect ‘critical technologies’ with anti-tamper and logistics/depot agreements that protect technologies at risk.
2. Consolidate the policy interagency process within the State, Commerce, and DoD, to ensure the United State is speaking with one voice regarding their support for or against a particular IACP approach before initiating an IACP.
3. Remove impediments to the international cooperative process such as the restrictions of the Buy American Act. Its existence alone speaks against the U.S. rhetoric for free international trade and a level playing field vis-à-vis international industry participation on the basis of ‘best value.’
4. Technology transfer and export controls must be relaxed to take advantage of the global market environment. The DoD is not taking advantage of the potential benefits of defense globalization. Competition fosters both innovation and lower costs for defense products.
5. Expedite the slow and inefficient process of export approval by consolidating the disparate National Disclosure Policy Committee and other policy/approval committees, such as the Service International Program Offices, special program committees such as the export committee for low observable and counter low observables, and security agencies within DoD such as the Defense Technical Service Administration and the Defense Threat Reduction Agency into a one-stop shop to vet exceptions to national disclosure policy, TAAs, technology transfers, and capability releases at all classification levels.
6. After international buy-in and monetary commitment, protect the program from bill-paying exercises that tend to push content to the right to saving money but costing the program more in the out years. Additionally, fence high-priority international programs

from ‘peanut-butter spread’ cut drills. Such practices increase a program’s cost and, in the case of international cooperative programs, significantly increase the probability of partner defection.

## **Program Managers**

1. Do not embark on an international cooperative armament path without political and strategic leadership top-cover.
2. Establish a streamlined interagency panel process led by an empowered voting body whereby issues can be quickly adjudicated.
3. Decide up front what are the “crown jewels”—what capabilities the U.S. is willing to give up and what they will not. Ensure capabilities are vetted by the entire nondisclosure policy community before starting development. Ensure those at the table are empowered to make decisions. Provide insight to these communities early and often during development as the technologies that enable the capabilities as they become more defined.
4. Clearly communicate expectations to the partners early to prevent later acrimony or possible defection. Ensure these agreements are specifically documented in the MOUs. Include in the MOUs the conditions and responsibilities regarding cost-sharing when program costs escalate. Do not make or intimate promises for which you have no authority.

## **Epilogue**

The recommendations from the Defense Science Board, shown in Figure 9, were made almost a decade ago. This research paper was completed before the author had access to the report. Consequently, the author’s recommendations above, particularly with respect to policy makers, were made without reference to the DSB recommendations. Interestingly, many of the recommendations of the DSB coincide with this paper. The following were major conclusions of that study:

First and foremost, the Task Force believes that there is a compelling need for international cooperation in the development and production of armaments—particularly with European allies. Without considerable changes in the ways that DoD and U.S. allies approach cooperation, however, the Task Force has concluded that efforts to develop and implement cooperative programs will likely meet with significantly less success than is needed.<sup>145</sup>

Currently, no single voice exists within OSD for the implementation of international programs. Each office has its own narrow goals and objectives, and views armaments cooperation from a parochial perspective (e.g., a dynamic tension exists between those who would share technology with allies and those who would hide it). DoD and U.S. industry are thus hindered in their ability to respond quickly to events, and achieve the cooperative agreements and industrial alliances required to compete in the global market.<sup>146</sup>

Of note, none of the DSB recommendations have been incorporated. Had they been, the JSF would have been spared many of the barriers addressed in this paper. It also raises an important question, why have the recommendations not been implemented?

Dr. Jacques C. Gansler, the task force chairman for the DSB report, became the Principal Undersecretary for Acquisition (AT&L) one year later. Consequently, he was in a major position to enact some of the changes. What were the institutional drivers that prevented recommendations of a Blue Ribbon Panel of acquisition and international experts from being adopted? It is the author's opinion they have not been adopted because of institutional inertia caused by bureaucratic unwillingness to relinquish authority that is not in their self-interest. Additionally, and perhaps more importantly, the recommendations lacked a champion above the level of change required. Dr. Gansler as USD(AT&L) was but one principal of three that were required to enact the necessary changes. Per the recommendations, USD (Policy) was to relinquish control of two agencies to AT&L (DTSA and DSAA). However, this never occurred. It is extremely difficult to get organizations to relinquish power for the sake of efficiency—true for any bureaucracy, and in spades for the world's largest.

Even though the Goldwater-Nichols Act was not popular with the services prior to its enactment, it is difficult to find anyone today who does not believe it was tremendously successful. It was a huge boon to the Combatant Commanders and, even more importantly, to the soldiers, sailors, and airmen in harm's way. It also would not have been implemented without the aid of Congressional champions and its enactment into law.

<b>OFFICE</b>	<b>ACTION ITEMS</b>
<b>SECDEF</b>	<ol style="list-style-type: none"> <li>1. Establish a clear national policy framework, based on the model, and assure that it is agreed to by OSD, the Services, other relevant agencies, and the Congress. Evolve this policy in consultation with potential international partners.</li> <li>2. Direct USD(A&amp;T) to review current and planned international arms cooperation efforts in light of framework.</li> <li>3. Merge the various, dispersed elements throughout DoD with responsibility for international acquisition and technology programs into a single, coherent organization. In particular, the SECDEF should: <ol style="list-style-type: none"> <li>a. Consolidate all OSD international implementation activities into one organization that reports to USD(A&amp;T), encompassing the functions of: <ol style="list-style-type: none"> <li>i. OSD International Programs Office</li> <li>ii. Defense Technology Security Administration (DTSA)</li> <li>iii. Defense Security Assistance Agency (DSAA)</li> </ol> </li> <li>b. Establish a position at the Assistant Secretary level to pro-actively manage these activities</li> </ol> </li> <li>4. Facilitate continuous involvement by senior leadership.</li> <li>5. Urge the Military Committee of NATO and the Major NATO Commands to give priority in their requirements generation activities to working with CNAD via the CAPS process.</li> </ol>
<b>USD(A&amp;T)</b>	<ol style="list-style-type: none"> <li>1. With the Service Secretaries, assign outstanding officers to international programs, and institute incentive structures. <ol style="list-style-type: none"> <li>a. Build in performance and career incentives that encourage international cooperation.</li> <li>b. Elevate international experience to the same level as "joint duty"</li> <li>c. Assure that cooperative programs are led by program managers with international/joint experience</li> </ol> </li> <li>2. Initiate a thorough training program to educate program managers.</li> <li>3. Establish administrative procedures that require that</li> </ol>

	<p>acquisition executives and program managers demonstrate serious attention to international opportunities. This should be required at the department-wide level for ACAT I programs, and in Service reviews for smaller-scale programs.</p> <ol style="list-style-type: none"> <li>4. Accelerate “acquisition reform”—with a focus on short cycle times—by providing special waivers to facilitate international programs (e.g., multi-year funding and DARPA’s “other agreements authority”</li> <li>5. Establish a project team to review 50 international programs, and make recommendations for long-term improvement. This team should be comprised of not more than 50 percent “internationalists,” and should deliberate for no more than six months.</li> <li>6. Propose CNAD, at its next meeting, that the results of the CAPS process be given higher priority.</li> </ol>
<b>USD(Policy)</b>	Create a special fast-track process within DoD for resolving technology transfer issues arising in international cooperative programs, and ask the State Department to collaborate in designing an expedited process outside DoD
<b>Service Secretaries</b>	Create Service incentives for international armaments cooperation by linking international programs to military missions and priority needs.
<b>CJCS</b>	Insert CINCs into the definition of coalition needs by convening them frequently enough to create an advocacy group for interoperability and relationship-building with other countries.

**Figure 9. DSB Recommendations to Increase IACP Opportunities for Success**

The DSB Task Force was under no illusions in this regard; indeed, the cover letter in the report admitted, “[r]ecognizing the inherent resistance to a change of this magnitude, the Task Force believes that sustained, high-level leadership is necessary for success.”<sup>147</sup>

The above changes will require an empowered champion at or above SECDEF to ensure the recommendations are implemented and to provide continued attention to monitor the progress and issue the necessary course corrections. An advocate above SECDEF may be required in order to enjoin the State Department to “collaborate in designing an expedited process outside of DoD.” Such lofty goals probably require an interagency Goldwater-Nichols Act to ensure they are implemented.

U.S. strategies, from the National Security Strategy to the National Military Strategy, have all paid lip service to the importance of international alliances and coalitions and the need to strengthen their capabilities. They all acknowledge that the best way to accomplish these



goals is through international cooperative armament programs, the Joint Strike Fighter program notwithstanding. Our armaments export law, policy, and regulations, however, remain divorced from our technology transfer policy because of unwillingness to release capabilities to key allies due to any number of concerns—most without merit. Cooperative relationships are heavily influenced by foreign policies of all parties. Since the 1960s the general trend in Europe has been to relax policies to encourage participation. The U.S., however, has leaned toward greater congressional assertiveness through protectionist means, introducing disparate interests.<sup>148</sup> The U.S. must formulate a national security and/or foreign policy basis that generates cooperation with the other parties.<sup>149</sup> At the end of the day the question comes down to how seriously the U.S. views the benefits of globalization. The answer will determine if the U.S. will be willing to take the next step, as painful as that may be, by dismantling ‘hard-wired’ laws and policies in order to enjoy the benefits of international cooperation.

## Appendix A

### Definitions

#### What Are International Armament Cooperative Programs?

The DISAMs manual identifies up to 12 different types<sup>150</sup> of cooperative programs.<sup>151</sup>

Cooperation and collaboration are terms often interchanged but can be defined as an agreement between two or more countries to share in the cost of development and production.

#### **International Cooperation (Collaboration) Defined:**

**Collaboration** is defined in Europe as an agreement between two or more countries to share in the cost of development and production. Further distinctions can be made based on the degree of interdependence between partners, including the presence or absence of work and technology sharing agreements and/or the existence of control/oversight through an international consortium. (International Military Aerospace Collaboration, p. 53).

Collaboration is a specific concept that applies to the engagement of two or more states in the specification, design, development, testing, and production of defense equipment.

**Cooperation** basically means getting other companies in other nations to supply the necessary components, parts, or even machine tools needed to develop defense equipment.

**Licensed Production** refers to states that cannot afford to develop equipment across the entire spectrum of weapons systems would seek to produce or assemble equipment or weapons systems under license from those states that can. (common approach with NATO countries, F-104, F-16).

**Foreign Military Sales** are when a state seeks to defray its R&D costs by selling them on the international market. The development costs are recouped by adding a stipend to the cost of the aircraft. In addition, economy of scales are realized, making the unit costs cheaper.

[Note each of these are approaches by nations to reduce their costs of development and production of aircraft.]

More authoritatively, Title 10 U.S.C. 2350a defines it this way:

(1) The term “cooperative research and development project” means a project involving joint participation by the United States and one or more countries and organizations referred to in subsection (a)(2) under a memorandum of understanding (or other formal agreement) to carry out a joint research and development program—

(A) to develop new conventional defense equipment and munitions; or

(B) to modify existing military equipment to meet United States military requirements.<sup>152</sup>

Further distinctions can be made based on the degree of interdependence between partners, including the presence or absence of work and technology sharing agreements and/or the existence of control/oversight through an international consortium.<sup>153</sup> Specifically, it is two or more states sharing costs, resources, or expertise toward any number of phases of weapon system acquisition to include requirements definition, specification, design, development, testing, and production. International cooperation can also mean other international companies supplying the necessary materials, parts, production techniques, tooling, or technologies to develop weapon systems. Whether it is collaboration or cooperation, both forms require a degree of technology transfer but only the former (collaboration) involves all entities assuming risks associated with the acquisition process. It is the degree of risk sharing that determines the level of international collaboration. When using international programs or IACPS, the definition of collaboration is intended in this paper, unless specifically noted otherwise

### **New International Cooperative Program Guidelines**

As of this year (July 2005), the new DoD 5000 series for acquisition requires DoD to evaluate potential opportunities to co-develop a new acquisition system with one or more allies before any joint or service specific alternative acquisition strategies are pursued (see order of preference list below). Consequently, all future acquisition programs will have to determine if co-development is in the US’s best interest, and if the answer is no, they must justify a US-only approach.

<b>Order</b>	<b>Acquisition Approach</b>
1.	Procurement or modification of commercial products, services, and technologies or dual-use technologies from domestic or international sources.
2.	Production or modification of previously-developed U.S. or allied systems.
3.	<b>Cooperative new development program with one or more allied nations.</b>
4.	New DoD joint service development program.
5.	New DoD single service-unique development program.

**Table A1. Acquisition Approach Order (DoD 5000.2)**

The justification for pursuing a cooperative program is documented on a Cooperative Opportunities Document (COD), which answers the four questions listed below. Based on the responses, the COD concludes whether cooperative development should be pursued.

1. Are there any similar projects in development or production by one or more major allies of the United States?
2. Could any of these projects satisfy, or be modified in scope, so as to satisfy the U.S. military requirements?
3. What are the advantages and disadvantages of trying to structure a cooperative development program? Things such as program timing, cost sharing, technology sharing and standardization should be addressed.
4. What are the opportunities for alternative forms of cooperation such as FMS, co-production, licensed production, component/sub-component co-development or incorporation of subsystems from allied sources and what are the advantages and disadvantages?

### **Anti-Tamper (AT)**

Anti-tamper is a general term that describes activities encompassing the system engineering process intended to prevent or delay exploitation of critical technologies in U.S. systems. These activities involve the entire life cycle of systems acquisition, including research, design, development, testing, implementation, and validation of anti-tamper measures. Properly employed, anti-tamper measures are designed to add longevity to a critical technology by deterring efforts to reverse engineer, exploit, or develop countermeasures against a system or system component. SAF/AQL is the AT executive agent for all of DoD.

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## **Interviews**

1. Lt General Michael C. Short (ret), JFACC and AFFOR Operation Allied Force, Maxwell AFB, AL, 10 November 2005.
2. Rear Admiral Steven L. Enewold, JSF Program Manager, Crystal City, VA, 9 November 2005.
3. Dr. Tom Cruse, Technical Director AFRL, Colonel Michael Leahy, Air Vehicles Directorate, AFRL, Maxwell AFB, AL, 19 Oct 2005.
4. Colonel Michael D. Williams, Wing Commander, Fighter and Attack, Air Force Material Command, former F-16 Systems Program Office Director, Wright-Patterson AFB, OH, 14 Sep 2005.
5. Mr. Warren Boley, VP Pratt and Whitney F-100 engines, telephone, 3 November 2005.
6. Lt Col Todd Johnston, Lead, JSF National Disclosure Policy, 9 November 2005

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## Endnotes

<sup>1</sup> *Report of the Defense Science Board Task Force on Joint Advanced Strike Technology Program*, Sept 1994, Memorandum for Chairman, Defense Science Board, May 10, 1994, p. 49

<sup>2</sup> *Hearing before the Subcommittee on National Security Emerging Threats and International Relations of the Committee on Government Reform House of Representatives*, 108<sup>th</sup> Congress, July 21, 2003, Serial No. 108-94, p. 10

<sup>3</sup> *Speech to Transatlantic Armament Cooperation*, 1996

<sup>4</sup> Known as the BUR for Bottom Up Review

<sup>5</sup> *Report of the Defense Science Board Task Force on Joint Advanced Strike Technology Program*, Sept 1994, Memorandum for Chairman, DSB, May 10, 1994, p. ES-1

<sup>6</sup> JSF Program Office Website, [http://www.jsf.mil/history/his\\_jast.htm](http://www.jsf.mil/history/his_jast.htm), downloaded on 1 Nov, 2005

<sup>7</sup> Program costs can be stated in many forms. The \$200B comprises the research and development phase (\$37B) with the procurement phase (\$162B) across the estimated 2,457 US aircraft planned purchase.

<sup>8</sup> The program later added \$3B to incorporate weight reduction measures and anti-tamper technologies.

<sup>9</sup> Wood, Christina, and David S. Sorenson, *International Military Aerospace Collaboration*, p. 1

<sup>10</sup> The partners will have a different configuration of the U.S. aircraft based upon disclosure policy and unique country requirements.

<sup>11</sup> Cook, Nick., "JSF—A Model for International Cooperation?" *Interavia*, Feb 1999.

<sup>12</sup> Ibid.

<sup>13</sup> The final Production and Sustainment MOU will specify firm orders from all partners should be finalized in 2006.

<sup>14</sup> This return on investment does not even take into account future opportunities in the production phase of the program.

<sup>15</sup> JSF Program Office, Mr. Michael Dorman, International Program Directorate

<sup>16</sup> JSF Program Office Website, [http://www.jsf.mil/program/prog\\_intl.htm](http://www.jsf.mil/program/prog_intl.htm), downloaded on 1 November, 2005

<sup>17</sup> Wood, Christina, and David S. Sorenson, p. 134

<sup>18</sup> Ibid., p. 134

<sup>19</sup> *The International Armaments Cooperation Handbook*, Office of the Director for International Cooperation, 3<sup>rd</sup> Edition, November 2004, p. 2

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<sup>20</sup> *The Management of Security Assistance Manual*, Defense Institute of Security Assistance Management, Wright-Patterson, AFB, OH, 2005, Ch. 19

<sup>21</sup> *The National Security Strategy of the United States of America*, September 2002, section viii.

<sup>22</sup> Barnett, P.M, Thomas, *The Pentagon's New Map: War and Peace in the Twenty-First Century*, p. 196

<sup>23</sup> *The National Security Strategy of the United States of America*, September 2002, section viii.

<sup>24</sup> *The National Defense Strategy of the United States of America*, March 2005, pp iii-iv and 1-20, Published by the Office of the Secretary of Defense, Washington DC, available at [http://www.globalsecurity.org/military/library/policy/dod/nds-usa\\_mar2005\\_iic.htm](http://www.globalsecurity.org/military/library/policy/dod/nds-usa_mar2005_iic.htm)

<sup>25</sup> Interview with Rear Admiral Steven L. Enewold, JSF Program Manager, Crystal City, VA, 9 November 2005.

<sup>26</sup> Interview with Colonel Michael Williams, Wing/CC, Fighter and Attack Programs, Wright-Patterson AFB, OH, September 14 2005

<sup>27</sup> Wood, Christina, and David S. Sorenson, p. 94

<sup>28</sup> Military Analysis Network, available at <http://www.fas.org/man/dod-101/sys/ac/row/f-2.htm>, downloaded on 6 October 2005

<sup>29</sup> Wood, Christina, and David S. Sorenson, p. 161

<sup>30</sup> *Ibid.*, p. 159

<sup>31</sup> The agreement was no longer in effect at the advent of the second Gulf War and the U.S. was not able to convince the Turks to allow combat sorties to pass through their airspace even after considerable pressure and the promise of \$38B in grants and loans.

<sup>32</sup> DoDD 5000.1

<sup>33</sup> GAO website, <http://www.gao.gov/sp/html/strojb228.html>, downloaded 2 Oct 05

<sup>34</sup> GAO report downloaded on 2 Oct 2005, <http://www.gao.gov/new.items/d05301.pdf>

<sup>35</sup> Wilson, George C., *This War Really Matters*, CQ Press, Washington D.C., p. 191

<sup>36</sup> Based on the cost of Silver at \$7.5/ounce and the B-1B unit cost of \$205M, and weight of 190,000 lbs. Information obtained at <http://www.boeing.com/defense-space/military/b1-lancer/b1bfacts.html> and <http://www.kitco.com/market/> downloaded on 6 November 2005

<sup>37</sup> Based on a nominal gold price of \$457/ounce and a B-2 unit cost of \$2.2B. Information obtained at

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<http://www.cdi.org/issues/aviation/B296.html> and

<http://www.kitco.com/market/> downloaded on 6 November 2005

<sup>38</sup> Based on the cost of Platinum, at \$934/ounce and the F-22A unit cost of \$139M. Information obtained at

<http://www.fas.org/sgp/crs/weapons/RL31673.pdf> and

<http://www.kitco.com/market/> an

<http://www.af.mil/factsheets/factsheet.asp?id=199> downloaded on 6 November 2005.

<sup>39</sup> Augustine, Norm, *Augustine's Laws*, p. 111

<sup>40</sup> 2001 year dollars

<sup>41</sup> Aboulafia, Richard, "World fighter market waits for JSF answers," *AIAA Magazine*, February 2002.

<sup>42</sup> Latest QDR number

<sup>43</sup> Australian Flight Test Services and Airpower Australia, October 2005

<sup>44</sup> The F-22A Unit Recurring Fly-away cost is approximately

\$120M/aircraft with 183 aircraft

<sup>45</sup> Linster, Bruce G., Slate, Lt Col Stephen, USAF, Waller, Robert L., "Consolidation of the U.S. Defense Industrial Base: Impact on Research Expenditures," *Acquisition Review Quarterly*, Spring 2002, p. 143

<sup>46</sup> While Perry appeared prescient, he was wrong in one respect. At the meeting with industry in 1993, Perry invited the top 12 companies and told them in five years he expected to only see half of them still around. By 2005, the top 15 were reduced to just 4.

<sup>47</sup> Deutch, John, "Consolidation of the U.S. Defense Industrial Base," *Acquisition Review Quarterly*, Fall 2001, p. 138

<sup>48</sup> Ibid, p. 139

<sup>49</sup> Defense Acquisition Performance Assessment, November 2005, Executive Summary, slide 34

<sup>50</sup> Ibid.

<sup>51</sup> Defense Systems Daily, "U.S. Defense Industry Global Partnerships," 1 June 2005, available at <http://defence-data.com/ripley/pagerip2.htm>, downloaded on 28 October 2005

<sup>52</sup> Curiously, the DSB report recommended against using an IACP model for JSF saying it would complicate the program to the point of reducing the probability of success.

<sup>53</sup> Cook, Nick., "JSF—A Model for International Cooperation?" *Interavia*, Feb 1999

<sup>54</sup> Wood, Christina, and David S. Sorenson, p. 142

<sup>55</sup> Ibid. p. 142



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<sup>56</sup> Tucker, Jonathan B., "Partners and rivals: a model of international collaboration in advanced technology," *International Organization*, Vol 45, Winter 1991, p. 83

<sup>57</sup> Lockheed Martin Aeronautics article, "Israel Contract adds to Lockheed Martin Firm Backlog, available, <http://www.prnewswire.com/cgi-bin/stories.pl?ACCT=104&STORY=/www/story/12-20-2001/0001637565&EDATE>, downloaded on 5 December 2005

<sup>58</sup> Shlachter, Barry, *Fort Worth Star-Telegram*, November 15, 2005

<sup>59</sup> Johnson, Rueben, F., "JSF Puts Squeeze on its European Rivals," *Aviation International News*, Farnborough 2002

<sup>60</sup> Patrick, Suzanne., DUSD(AT&L) Industrial Policy, Statement before the Subcommittee on National Security, Emerging Threats, and International Relations, House of Representatives, 21 July 2003., p. 40

<sup>61</sup> The President may waive these fees for selected FMS countries, South Korea is asking for such a waiver on their recent FMS purchase of F-15K's.

<sup>62</sup> Patrick, Suzanne, DUSD (AT&L) Industrial Policy, Statement before the Subcommittee on National Security, Emerging Threats, and International Relations, House of Representatives, 21 July 2003, p. 41

<sup>63</sup> *National Defense Strategy of the United States of America*, Chapter 2, A Defense Strategy for the 21<sup>st</sup> Century, March 2005

<sup>64</sup> David S. Yost, "The NATO Capabilities Gap and the European Union," *Survival*, Winter 2000/2001, p. 103

<sup>65</sup> Clancy, Tom, and Lt Gen (ret) Chuck Horner. *Every Man a Tiger: The Gulf War Air Campaign*, p. 526

<sup>66</sup> Ibid., p. 546

<sup>67</sup> Lamartin, Glenn F., *AT&L Needs and Initiatives*, briefing presented to the NDIA Systems Engineering Conference, October 2004, slide 4

<sup>68</sup> *National Defense Strategy of the United States*, section III, para. 8

<sup>69</sup> David S. Yost, "The NATO Capabilities Gap and the European Union," *Survival*, Winter 2000/2001, p. 103

<sup>70</sup> Ibid.

<sup>71</sup> Per Joint Publication, five combatant commands have responsibilities for the conduct of the U.S. security assistance program within their respective geographical regions.

<sup>72</sup> The COCOM staff was first sent the questionnaire. The Blue Team members then and briefed the respective air component commanders and requested they fill out the matrix of capabilities. Once this was

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accomplished, the team briefed each COCOM in-turn on the results and asked for their concurrence or non-concurrence.

<sup>73</sup> Interview with Lt Gen (ret) Michael C. Short, Maxwell AFB, AL, 10 November 2005

<sup>74</sup> Yost, p. 105

<sup>75</sup> DoDD 5000.1, Defense Acquisition Systems, para E1.1.13

<sup>76</sup> JSF Program Office Briefing given to the AFA conference, 13 Sep 2005, Slide 21

<sup>77</sup> Asti, Corinne, "The F-35 JSF in Europe: The Consequences of Pragmatism," *CeMiSS Quarterly*, Summer 2005, p. 95

<sup>78</sup> Augustine, p. 14

<sup>79</sup> Interview with Rear Admiral Steven L. Enewold, JSF Program Manager, Crystal City, VA, 9 November 2005.

<sup>80</sup> Ibid.

<sup>81</sup> Ibid.

<sup>82</sup> Interview with Mr. Warren Boley, VP F100 engines, Pratt and Whitney, telephone, 3 November 2005.

<sup>83</sup> Ibid.

<sup>84</sup> Major General John L. Hudson, JSF Program Manager, Statement before the Subcommittee on National Security, Emerging Threats, and International Relations, House of Representatives, 21 July 2003, p. 48

<sup>85</sup> Tucker, p. 115

<sup>86</sup> Hearing before the Subcommittee on National Security Emerging Threats and International Relations of the Committee on Government Reform House of Representatives, 108<sup>th</sup> Congress, July 21, 2003, Serial No. 108-94, p. 11

<sup>87</sup> Enewold interview

<sup>88</sup> Johnson, Rueben, F., "JSF Puts Squeeze on its European Rivals," *Aviation International News*, Farnborough 2002

<sup>89</sup> Wood, Christina, and David S. Sorenson, pp. 155-158

<sup>90</sup> Ibid, p. 161

<sup>91</sup> The 'Exchange of Letters' began as an unofficial letter from the UK MoD to the U.S. that outlined desired logistics and sustainment agreements following the system development and demonstration program. Other partner's, upon hearing of the letters, also forwarded their own versions.

<sup>92</sup> Both Italy and the UK have intimated that unless their grievances are addressed they may be required to withdrawal

<sup>93</sup> Enewold interview

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<sup>94</sup> GAO report downloaded on 2 Oct 2005,  
<http://www.gao.gov/new.items/d05301.pdf>

<sup>95</sup> Hearing before the Subcommittee on National Security Emerging Threats and International Relations of the Committee on Government Reform House of Representatives, 108<sup>th</sup> Congress, July 21, 2003, Serial No. 108-94, p. 1

<sup>96</sup> GAO report on Joint Strike Fighter Acquisition, Report to the Chairman, Subcommittee on National Security, Emerging Threats and International Relations, committee on Government Reform, GAO, July 2003.

<sup>97</sup> Hudson testimony, p. 52

<sup>98</sup> Ibid.

<sup>99</sup> Finland built 61 F-18 Hornets, and Canada built 138. Turkey and Israel also co-produced F-16 aircraft.

<sup>100</sup> Wood, Christina, and David S. Sorenson, pp. 172, 186

<sup>101</sup> Wood, Christina, and David S. Sorenson, p. 89

<sup>102</sup> Ibid.

<sup>103</sup> Ibid., pp. 18, 95, 103

<sup>104</sup> Ibid., p. 16

<sup>105</sup> It is noteworthy that after all the hand-wringing and acrimony over the Japanese plundering our advance technologies, neither side believes today it reaped all that much benefit.

<sup>106</sup> Melloan, George, "Technology Transfer in Weapons is a Two-Way Street," *The Wall Street Journal*, 14 Nov 1989, p. 1

<sup>107</sup> Boley interview

<sup>108</sup> Interview with Dr. Tom Cruse, Technical Director, Air Force Research Laboratory, Maxwell AFB, AL, 19 October 2005.

<sup>109</sup> Hudson testimony, p. 56

<sup>110</sup> Interview with Colonel Michael Leahy, PhD, Air Vehicles Director, Air Force Research Laboratory, Maxwell, AFB, AL, 19 October 2005.

<sup>111</sup> Leahy interview

<sup>112</sup> Leahy interview

<sup>113</sup> Alan Kay actually said "The best way to *predict* the future is to invent it."

<sup>114</sup> *The National Defense Strategy of the United States of America*, March 2005, pp iii-iv and 1-20, Published by the Office of the Secretary of Defense, Washington DC, available at [http://www.globalsecurity.org/military/library/policy/dod/nds-usa\\_mar2005\\_iic.htm](http://www.globalsecurity.org/military/library/policy/dod/nds-usa_mar2005_iic.htm)

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<sup>115</sup> Bialos, Jeffery P., “Last Supper Fallout: Can Defense Industry Meet Tomorrow’s Challenges, *Defense News*, November 2003

<sup>116</sup> Clancy, Tom, and Lt Gen (ret) Chuck Horner, p. 554

<sup>117</sup> F-14 Tomcat, *Wikipedia encyclopedia*, available on-line at [http://en.wikipedia.org/wiki/F-14\\_Tomcat](http://en.wikipedia.org/wiki/F-14_Tomcat), downloaded 12 November 2005

<sup>118</sup> US Navy website, available on-line at <http://navysite.de/cg/cg49.html>, downloaded 12 November 2005

<sup>119</sup> “Venezuela threatens US over F-16’s,” *BBC News*, 2 November 2005

<sup>120</sup> Not one of the COCOMs, in the Blue Team study, expressed concerns over JSF’s getting into the hands of a rogue nation.

<sup>121</sup> Augustine, p. 248

<sup>122</sup> Gold plating is derisive term to describe the addition of capabilities that are not warranted by the baseline requirements. They can be “nice to have” but often only contribute to increased cost of development.

<sup>123</sup> General Accountability Office (GAO) report on Cost and Cycle Time Growth for 26 Weapon Systems, available at <http://www.gao.gov/new.items/do5301.pdf>, downloaded on 2 Oct 2005.

<sup>124</sup> Wood, Christina, and David S. Sorenson, p. 75

<sup>125</sup> JSF was able to establish requirements in the Concept Development Phase with partners ensuring their requirements were incorporated. The program was careful to ensure the MOU’s addressed nation-unique requirements from the baseline configuration. If a country wanted to integrate a unique capability or weapon, the MOU required them to pay for that change.

<sup>126</sup> Interview with Colonel Michael Williams, Wing/CC, Fighter and Attack Programs, Wright-Patterson AFB, OH, 14 September 2005.

<sup>127</sup> Patrick, Suzanne, DUSD(AT&L) Industrial Policy, Statement before the Subcommittee on National Security, Emerging Threats, and International Relations, House of Representatives, 21 July 2003, p. 41

<sup>128</sup> 10 U.S.C. 2350a, Section 2751 22 U.S.C. 2751 [Section 1, *Arms Export Control Act (AECA)*], and 10 U.S.C. 2531.

<sup>129</sup> DTSA SAP Report for the 2005 Budget Estimate Submission, available on-line at

[http://www.defenselink.mil/comptroller/defbudget/fy2005/budget\\_justification/pdfs/operation/Volume\\_1\\_-\\_DW\\_Justification/DTSA\\_FY05\\_PB.pdf](http://www.defenselink.mil/comptroller/defbudget/fy2005/budget_justification/pdfs/operation/Volume_1_-_DW_Justification/DTSA_FY05_PB.pdf)

<sup>130</sup> Enewold interview

<sup>131</sup> *International Armaments Cooperation Handbook*, 3<sup>rd</sup> Edition, November 2004, p. 7, available at: <http://www.acq.osd.mil/ic/>

<sup>132</sup> *Ibid.*, p.7

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<sup>133</sup> Patrick, Suzanne, p. 41

<sup>134</sup> Smyth, Lt Col Joseph, S., "The Impact of the Buy American Act on Program Managers," *Acquisition Review Quarterly*, Summer 1999, p. 263

<sup>135</sup> Senator Russ Feingold, Speech on the Buy American Act, July 29, 2003

<sup>136</sup> Smyth, p. 268

<sup>137</sup> Ibid., p. 266

<sup>138</sup> Ibid., p. 268

<sup>139</sup> NDP establishes a framework for the approval or denial of critical military information to foreign governments. Basis authority and policy for transferring classified information is contained in the National Security Decision Memorandum (NSDM) 119, which is stated as 5 criteria in the DoDD 5230.11.

<sup>140</sup> Anti-tamper is a general term that describes activities encompassing the system engineering process intended to prevent or delay exploitation of critical technologies (see Appendix).

<sup>141</sup> The exceptions to NDP and export release approval process began in late 2001. A first configuration was not approved until late 2002 but even then required multiple 'come-backs' to the various committees for updates and approvals. The UK, as a tier I partner, would ostensibly be the first to receive their aircraft, but this wouldn't be until 2014 at the earliest, 13 years after the approval process began.

<sup>142</sup> Major Ross McNutt, P.H.D., "Reducing Air Force Acquisition Response Times: Evolutionary Acquisition and Spiral Development," 13 September 2000.

<sup>143</sup> JSF was delayed 10 months due to a 4000 lb weight reduction requirement during SDD.

<sup>144</sup> Defense Acquisition Performance Assessment, Executive Summary, slide 34

<sup>145</sup> Report of the Defense Science Board Task Force on International Armaments Cooperation, "International Armaments Cooperation in an Era of Coalition Security," August 1996. p. 8

<sup>146</sup> Ibid., p. 6

<sup>147</sup> Ibid. Cover letter to the report.

<sup>148</sup> Hamilton, Lee H., Tama, Jordan, "Changes in the Making of Foreign Policy," Air War College, National Security and Decision Making Reader, AY06, p. 433

<sup>149</sup> Wood, Christina, and David S. Sorenson, p. 134

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<sup>150</sup> Includes: Collaboration, Consortium/Consortia, Cooperative Research and Development, Co-production/Assembly, Family of Weapons, Government led Initiative, Industry led Initiative, Joint Venture, Licensed Production, Mergers and Acquisitions, Strategic Alliances, and Teaming.

<sup>151</sup> *Management of Security Assistance*, Defense Institute of Security Assistance Management, Wright-Patterson AFB, OH, Chapter 19

<sup>152</sup> Title 10 U.S. Code Section 2350a

<sup>153</sup> Wood, Christina, and David S. Sorenson, p. 53